Management Plan

January 1991

CHESAPEAKE BAY

NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM

VIRGINIA

Commonwealth of Virginia
L. Douglas Wilder, Governor

Virginia Institute of Marine Science
The College of William and Mary
P.O. Box 1346
Gloucester Point, Va. 23062

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service
Office of Ocean and Coastal Resource Management
1825 Connecticut Ave., N.W.
Washington, D.C. 20235

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ACKNOWLEDGMENTS

The Final Environmental Impact Statement/Final Management Plan (Chesapeake Bay National Estuarine Research Reserve System in Virginia, 1991) was published in January 1991, prepared by the following project team at VIMS: Carroll Curtis, project director and Reserve director through March 1992; Sandra Hartenstine, research assistant; Paula Hill, research assistant; and Tammy Rowe, laboratory technician.

Extracted from that publication, this management plan was prepared in 1992-93 under the direction of Maurice P. Lynch, Reserve director, and with the help of Carroll Curtis. Bland Crowder, education coordinator and communicator, edited and designed the plan. Lisa Ayers, graduate assistant, was the editorial assistant.

Portions of the management plan were developed by Carvel Blair (research and monitoring plan), Mary Causey (volunteer plan) and Carol Rideout (education plan).

Many other organizations and individuals helped in site evaluation, designation, and development of the management plan. The York Chapter of the Chesapeake Bay Foundation was particularly supportive.

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UNITED STATES DEPARTMENT OF COMMERCE
The Under Secretary for
Oceans and Atmosphere
Washington, D.C. 20230

DESIGNATION OF THE CHESAPEAKE BAY
NATIONAL ESTUARINE RESEARCH RESERVE IN VIRGINIA
GOODWIN ISLANDS, CATLETT ISLANDS, TASKINAS CREEK
AND SWEET HALL MARSH COMPONENTS

Consistent with the provisions of section 315 of the Coastal Zone Management Act, 16 U.S.C. § 1461, the Commonwealth of Virginia has met the following conditions to establish Goodwin Islands, Catlett Islands, Taskinas Creek, and Sweet Hall Marsh as components of the Chesapeake Bay National Estuarine Research Reserve in Virginia.

1) Goodwin Islands, Catlett Islands, Taskinas Creek, and Sweet Hall Marsh are representative ecosystems that are suitable for long-term research and contribute to the biogeographical and topological balance of the National Estuarine Reserve Research System.

2) Virginia state laws provide long-term protection for reserve resources to ensure a stable environment for research.

3) Designation of Goodwin Islands, Catlett Islands, Taskinas Creek, and Sweet Hall Marsh as reserve components will serve to enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation.

4) The Commonwealth of Virginia has complied with the requirements of the regulations relating to designation of a National Estuarine Research Reserve.

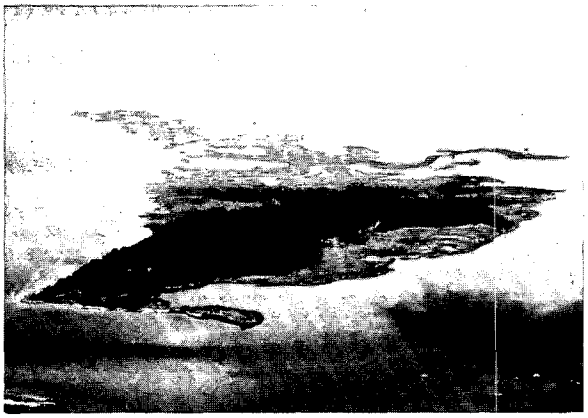
Accordingly, I hereby designate the areas of Goodwin Islands, Catlett Islands, Taskinas Creek, and Sweet Hall Marsh as components of the Chesapeake Bay National Estuarine Research Reserve in Virginia, the boundaries of which are specified in the final management plan.

Jean for Jay Nelson, Assistant Secretary (for)
John A. Knauss
Under Secretary for Oceans
and Atmosphere

THE ADMINISTRATOR

THE FOUR YORK RIVER RESERVE SITES

Goodwin Islands



Catlett Islands

Taskinas Creek

Sweet Hall Marsh

INTRODUCTION

The Chesapeake Bay, the nation's largest estuary, lies within its own sub-biogeographic region, the Virginian Province, which extends from Cape Cod to Cape Hatteras. The Chesapeake Bay proper is approximately 200 miles long, running from the Virginia capes at its mouth to the Coniwingo Dam on the Susquehanna River in Maryland. The tidal Bay and its tributaries are shared by the states of Maryland and Virginia and touch upon the District of Columbia. The 64,000-square-mile drainage basin extends into Pennsylvania, Delaware, West Virginia and New York.

Both Maryland and Virginia are developing and administering multiple-site components of a National Estuarine Research Reserve (Figure 1). Each state is developing a system that best meets its needs, but both are coordinating their efforts to ensure that representative habitats of the Chesapeake, "the nation's estuary," are well represented within the National Estuarine Research Reserve System.

The National Estuarine Research Reserve System (Figure 2) was established in 1972 as the National Estuarine Sanctuary Program under Section 315 of the Coastal Zone Management Act. In April 1986, the name of the program was changed to the National Estuarine Research Reserve System by the Coastal Zone Reauthorization Act of 1985. At the same time, the role of the Research Reserves in addressing national estuarine research and management issues was emphasized, as was the need to make maximum use of the system for research purposes through coordination with NOAA and other federal and state agencies that sponsor estuarine research. The program is administered within the Sanctuaries and Reserves Division of the National Oceanic and Atmospheric Administration.

CHESAPEAKE BAY–VIRGINIA: A RESERVE'S BEGINNINGS

In July 1988, the Chesapeake Executive Council, made up of the governors of Maryland, Pennsylvania and Virginia; the mayor of the District of Columbia; the chair of the Chesapeake Bay Commission; and the administrator of the Environmental Protection Agency, representing the U.S. government, established as one of the Bay region's research support priorities the "establishment of a system of research reserves which will provide the research community with sites for long-term habitat focused research that will be protected as far as possible from immediate threats from development."

It is within this context that the Commonwealth of Virginia began its planning for the Chesapeake Bay National Estuarine Research Reserve System in Virginia. The Virginia Institute of Marine Science, a component of The College of William and Mary and the Commonwealth's designated marine research laboratory, was designated by the governor to take the lead role in establishing a suitable research reserve system for the Commonwealth.

When the Commonwealth's Chesapeake Bay concerns were reviewed, it soon became apparent that the greatest concerns focused on the major Western Shore tributaries, mainly the James, York, Rappahannock and Potomac rivers. It was decided that an estuarine research reserve system suitable for Virginia would have to contain the range of habitats found along both the tributaries and the mainstem of the Bay. In addition, because different land-use patterns characterize the drainage basin of each tributary, sites should be selected on each tributary and along the mainstem to allow research on and monitoring of the effects of development in those drainage basins.

SEGMENTATION BY SALINITY: REPRESENTATIVE SITES

A research reserve planning group reviewed various schemes devised to divide the Chesapeake Bay and its tributaries into subsections, settling on a segmentation scheme, developed in the early days of the Chesapeake Bay Restoration program, that divides the main tributaries into three segments, a lower estuarine reach, a transition zone, and a tidal freshwater reach. It also divides the mainstem

Figure 1
CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM IN VIRGINIA AND MARYLAND

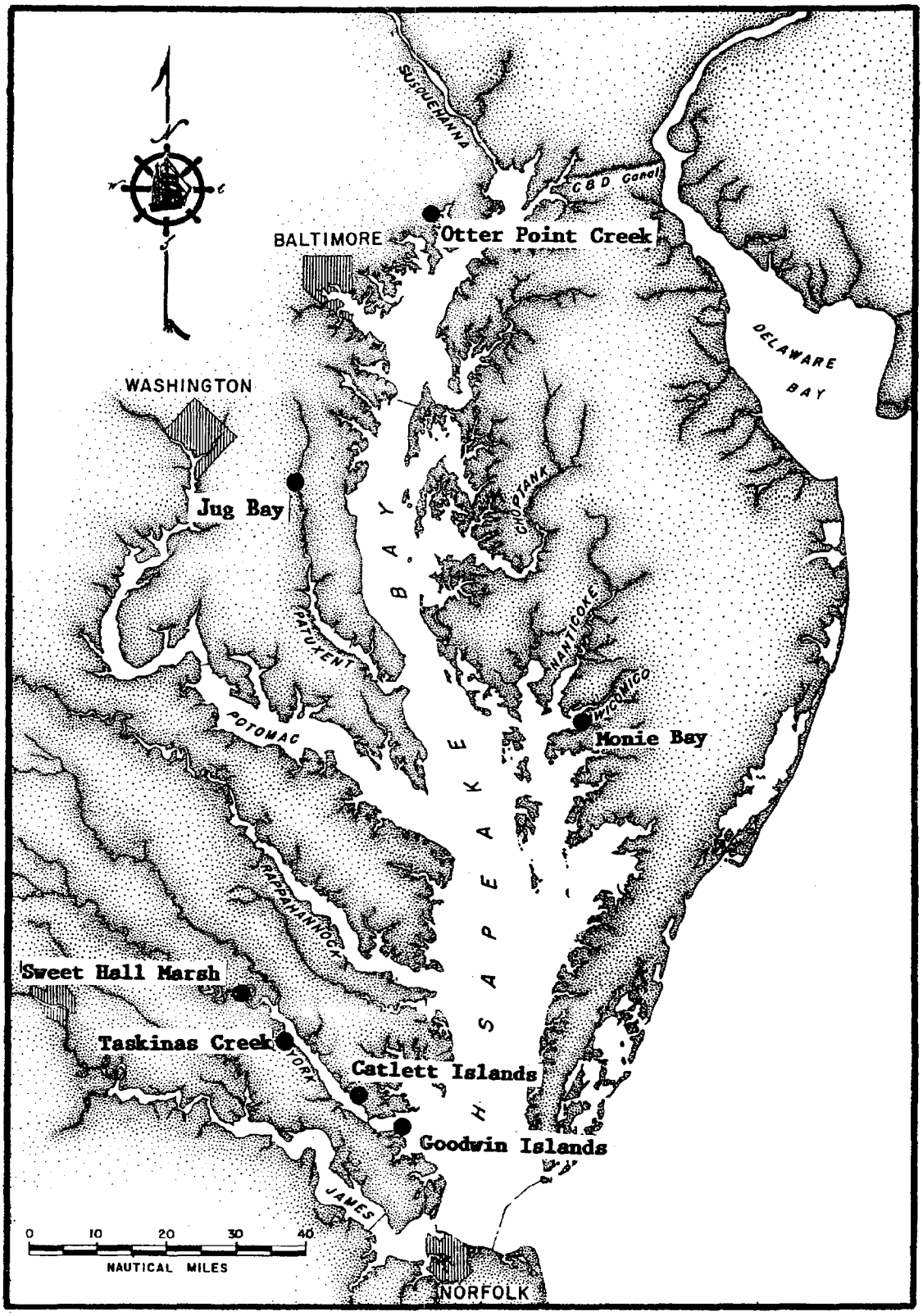


Figure 2
NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM

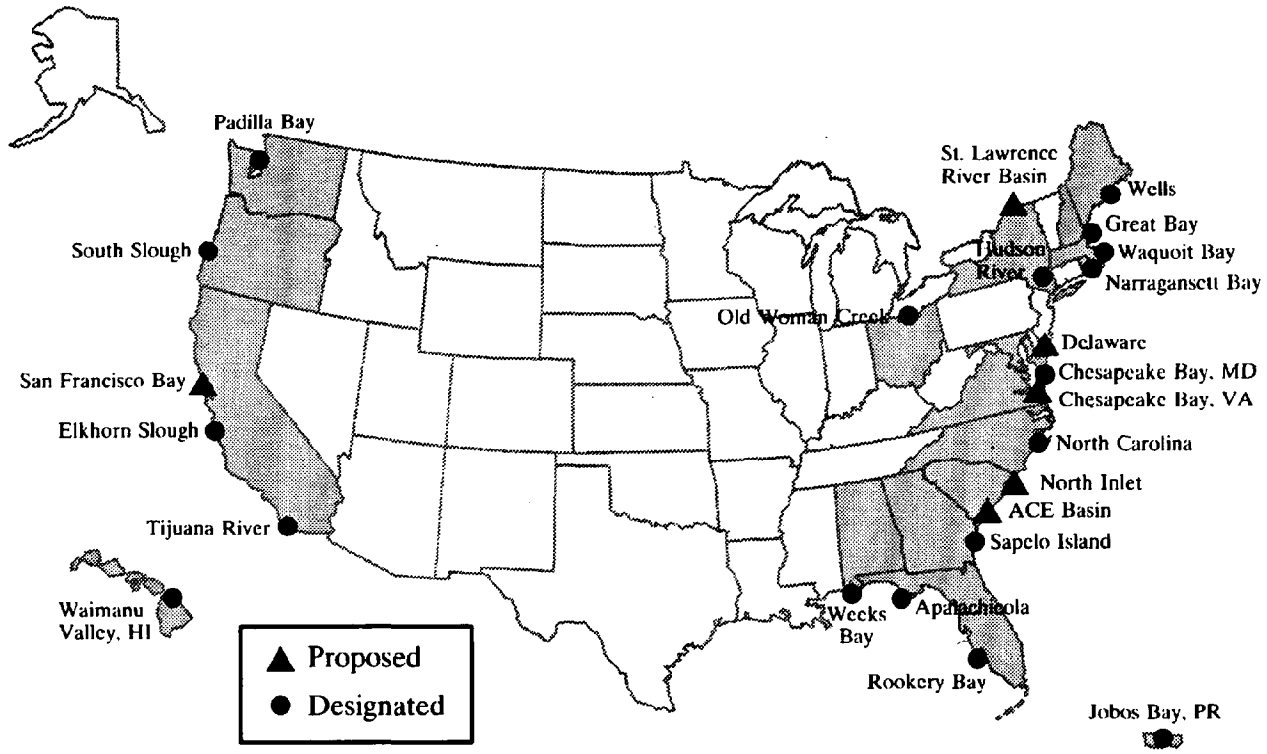
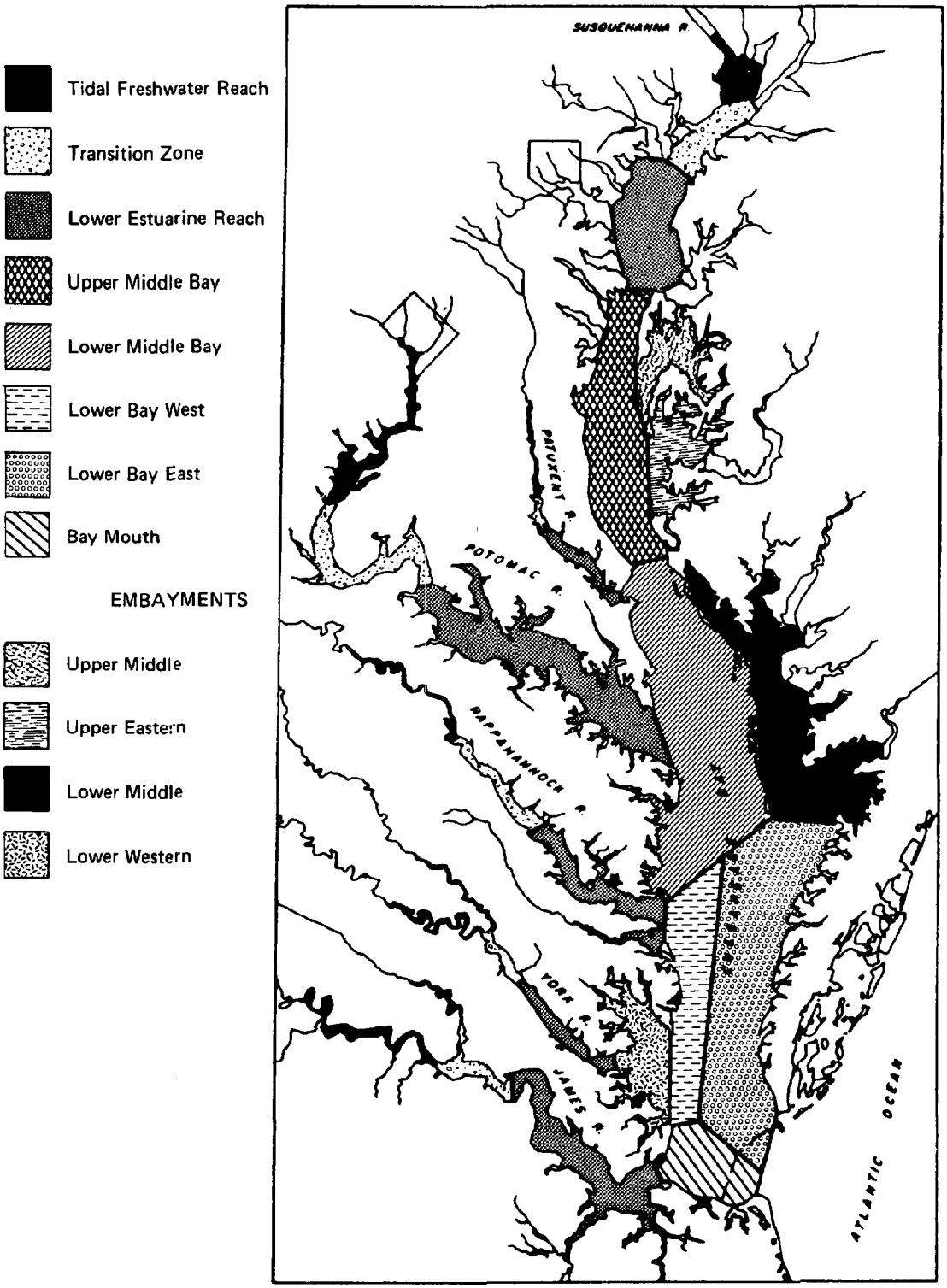


Figure 3
CHESAPEAKE BAY SEGMENTATION SCHEME



of the Bay into a number of embayments and distinct segments. The overall planning goal became the location and designation of at least one representative habitat in each designated section. On that basis, the Chesapeake Bay National Estuarine Research Reserve System in Virginia eventually might include more than 20 sites.

It was decided to develop the program tributary by tributary, starting with the York River system, the Mobjack embayment, the York proper and the Pamunkey River, highlighting the importance of including sites representing the salinity regimes along an estuary. The York River was chosen first because of logistics: site identification would be easier on the York because VIMS was located in its lower estuarine reach, allowing development and testing of a site evaluation scheme on an estuarine system familiar to VIMS scientists and staff.

SITE ASSESSMENT AND SELECTION

The effort began with reevaluation of all areas listed in an early Smithsonian compilation of coastal natural areas of the Chesapeake Bay, providing a list of 18 sites in the York system. Those sites were evaluated using the general criteria promulgated by NOAA's Office of Ocean and Coastal Resource Management, as expanded by VIMS to fit the specific situation found in Virginia's portion of the Chesapeake Bay.

Each site initially identified was ranked in terms of biological representation, ecological characteristics, naturalness, research potential, educational opportunities, and management considerations. This process used expert panels made up of state, federal and local agency personnel and scientists from several Virginia colleges and universities. Close coordination was maintained with citizen organizations and several industry leaders in the York basin.

By this process, four sites were identified as priority candidates for inclusion in the York River component of the Chesapeake Bay National Estuarine Research Reserve System in Virginia: the Goodwin Islands at the mouth of the York River (Mobjack embayment), the Catlett Islands in the lower transitional reach, Taskinas Creek in the transition zone, and Sweet Hall Marsh in the tidal freshwater Pamunkey River. The landowners of these properties were contacted, and most agreed to enter into various legal agreements with VIMS and William and Mary, allowing their holdings to be incorporated into the program. The specific agreements are included as Appendix A.

PLAN FOR RESERVE MANAGEMENT

This Management Plan details the objectives and goals of the research, education, monitoring and resource management plans for the York River component of the Reserve. In addition to the specific details that are spelled out in this document, the Reserve will be managed in accordance with the National Estuarine Research Reserve System Program Regulations promulgated by NOAA in the *Federal Register.* The version current as of January 1991 is included in the Final Environmental Impact Statement/Final Management Plan for the Reserve (Chesapeake Bay National Estuarine Research Reserve System in Virginia, 1991) and therefore is not reproduced here.

Characterization of the York River sites included compilation of species lists. The species lists also were included in the Final Environmental Impact Statement/Final Management Plan for the Reserve (Chesapeake Bay National Estuarine Research Reserve System in Virginia, 1991) and are not presented here.

After the York River component is designated, site selection will move to the Potomac and Rappahannock river basins. When those tributary sites are identified and under review by NOAA and other state, federal and local agencies, the site identification process will move to the James River, the mainstem, and other embayments on the Eastern and Western shores of the Bay.

MANAGEMENT BACKGROUND

THE MULTI-SITE SYSTEM

As the nation's largest estuary, the Chesapeake Bay contains a diverse collection of habitats and salinity regimes and is subject to different human stresses in various locations. In light of these differences, selecting one Reserve site to characterize the Chesapeake Bay was neither appropriate nor practical. To develop a more accurate picture of the Bay conditions, the Commonwealth of Virginia and NOAA agreed to a multiple-site Chesapeake Bay National Estuarine Research Reserve System in Virginia which collectively represent Virginia's Chesapeake Bay. The multi-site system better reflects the diversity of habitats in the Chesapeake Bay subregion and permits development of complementary research and education programs within the components of the Reserve. It maximizes the application of research and monitoring results to pertinent management decisions at state and local levels. In addition, multiple sites make education programs available to a greater percentage of the state populace than would be reached by a single site.

The designation of sites is being conducted in phases, with each phase corresponding to specific geographic regions of the Virginia portion of the Chesapeake Bay and its tidewater tributaries. For administrative purposes, these regions are grouped as follows: York River basin; Rappahannock River and Potomac River (Virginia shoreline) basins; James River basin and Western Shore of the Chesapeake Bay; and Eastern Shore (Bayside) of the Chesapeake Bay. An assessment of the York River basin sites has been completed; this management plan addresses the designation of York River sites. It is anticipated that the next phase of site selection, nomination, and designation (i.e., for sites in the Rappahannock and Potomac River basins) will begin after the designation of York River sites, contingent upon the availability of funds and demonstrated public interest in program expansion. The need for further program expansion will be assessed after the second phase is completed. When fully established, the Chesapeake Bay National Estuarine Research Reserve System in Virginia could have as many as 20 Reserve sites.

The first components, located within the York River basin, are: (1) **Goodwin Islands**, at the mouth of the York River offshore a moderately dense residential and industrial area of Yorktown; (2) **Catlett Islands**, in an area of increasing residential density on the north shore of the York River; (3) **Taskinas Creek**, within York River State Park, surrounded by low to moderately dense rural development on the south shore of the York River; and (4) **Sweet Hall Marsh**, in a low-density, rural area along the Pamunkey River, a tidal tributary to the York River.

RELATIONSHIP WITH THE CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE IN MARYLAND

The goal of the National Estuarine Research Reserve System is to represent, with at least one estuarine Reserve, each biogeographic region of the United States and to represent the major estuarine types found in each region. Usually an estuary is represented by a single state and a single National Estuarine Research Reserve. However, the Chesapeake Bay, because of its large size and diversity, cannot be easily represented by a single Reserve. Therefore, the Commonwealth of Virginia and the State of Maryland has each been given the opportunity to have a Chesapeake Bay National Estuarine Research Reserve System.

In order to create strong research and educational programs and a comprehensive system of Reserve sites throughout the Chesapeake Bay, Virginia and Maryland have coordinated many of their efforts. One of the first actions taken in 1986 was to meet and develop compatible site selection criteria. This ensured that sites eventually selected in the two states would be complementary and would form a comprehensive Bay-wide net-

work of Research Reserves. The major categories for site selection included representativeness value for research, value for education, and practical management considerations.

The need to establish a system of Research Reserve sites throughout the Chesapeake Bay is recommended in the *Comprehensive Research Plan for the Chesapeake Bay Program* (Chesapeake Executive Council, 1988a). It is anticipated that once sites are designated, scientists from the Bay community may elect to use any combination of the sites in Virginia and Maryland suitable for their research projects.

Virginia and Maryland will continue to administer their Reserves as separate entities reflecting the management, political and other differences between the two states. Each state is eligible for the complete complement of federal funding assistance, has its own state funding mechanism, and has its own staff. The Chesapeake Bay National Estuarine Research Reserve in Maryland is located in the Department of Natural Resources, Tidewater Administration, Coastal Resources Division.

THE VIRGINIA COMPONENTS, AND HOW THEY ARE RELATED

The first four Virginia Reserve component sites represent the different ecological zones of the York River as defined by the Chesapeake Bay segmentation scheme (Figure 3). All four sites are natural areas that have received little disturbance by humans. They are sites of active research, some educational activities, and site-specific traditional activities such as hunting, fishing, crabbing, hiking, and recreational boating.

The GOODWIN ISLANDS site consists of an archipelago of marsh islands surrounded by submerged vegetation beds, oyster reefs and shallow open estuarine waters. The largest island is forested. Located at the mouth of the York River within the Mobjack embayment of the western shore, the Goodwin Islands represent polyhaline salinity conditions (16-22 parts per thousand). The property has been donated by the Endowment Association of the College of William and Mary in Virginia Inc. to the College's Board of Visitors for incorporation into the Reserve System.

The CATLETT ISLANDS are located approximately 19 nautical miles (nmi) from the mouth of the York River and represent mesohaline conditions (8-18 ppt). They lie within the lower estuarine reaches of the York River. The islands consist of parallel ridges of forested wetlands surrounded by extensive saltmarshes along with adjacent shallow bottoms and water areas where aquatic vegetation once flourished. The property is privately owned and is being incorporated into the Reserve System through conservation easements and a management agreement.

TASKINAS CREEK represents the transition zone of the York River (3-13 ppt) and consists of a tidal creek with fringing marshes that grade from brackish to freshwater-dominated communities. The non-tidal portion contains feeder streams that drain mesic oak-hickory forests, maple-gum-oak-ash swamps, and freshwater marshes (Hobbs et al., 1975b). Much of the creek watershed is undeveloped and lies within the boundaries of York River State Park. A memorandum of understanding between the Virginia Institute of Marine Science and the Virginia Department of Conservation and Recreation has been signed.

SWEET HALL MARSH occupies a broad meander of the Pamunkey River, a tributary to the York River and one of the most pristine rivers on the East Coast. It consists of an extensive tidal freshwater marsh with adjacent non-tidal bottomland forest on the mainland side and shallow flats on the seaward side. This combination of ecosystem types is representative of tidal freshwater conditions (0-0.5 ppt) within the upper reaches of the York River system. The property is privately owned and management agreements between the owners and VIMS have been signed.

Complementary programs of research and education will be developed to make best use of the characteristics particular to each site

concomitant with protecting the sites from human impact. For example, because Taskinas Creek is an area of ongoing environmental education, is easily accessible, is located close to populated areas of moderate but growing density, and has facilities and improvements to accommodate increased educational use, it will be the focus of the System's public education programs. Catlett Islands and Sweet Hall Marsh, on the other hand, are areas of ongoing baseline research, which requires undisturbed conditions. The sites are pristine, relatively inaccessible, and remote from industrial and urban centers, which makes them ideal for continued use in environmental characterization and monitoring studies. The Goodwin Islands are also an area of ongoing research and education but are located near moderately densely populated areas and tourist attractions. Access to the site is possible only by water, and some sections of the largest island show signs of human disturbance. Use of the Goodwin Islands will be kept at current levels of research and education while studies are conducted on possible visitor impacts and the need for restoration.

The Chesapeake Bay National Estuarine Research Reserve System in Virginia will be managed to achieve National Estuarine Research Reserve objectives. Each component will have its own program to meet individual research, education and general use needs. All of the programs will be coordinated by VIMS.

SITE LOCATIONS AND ACCESS

GOODWIN ISLANDS The Goodwin Islands are located near the mouth of the York River at the northeastern tip of York County (Figure 4). They are separated from the mainland on the west by the Sand Box Thorofare, which varies in width from 1/8 to 1/2 nmi. The islands are bounded on the north by the York River and on the east and south by the Chesapeake Bay. They are located approximately 12 nmi from VIMS and a public boat ramp under the Coleman Bridge.

The Goodwin Islands are accessible only by boat. There are no piers on the islands and visitors must moor their boats and wade ashore. The islands can be seen from the mainland along state routes 629, 656 and 622. There are no boat-launching facilities on any of those roads.

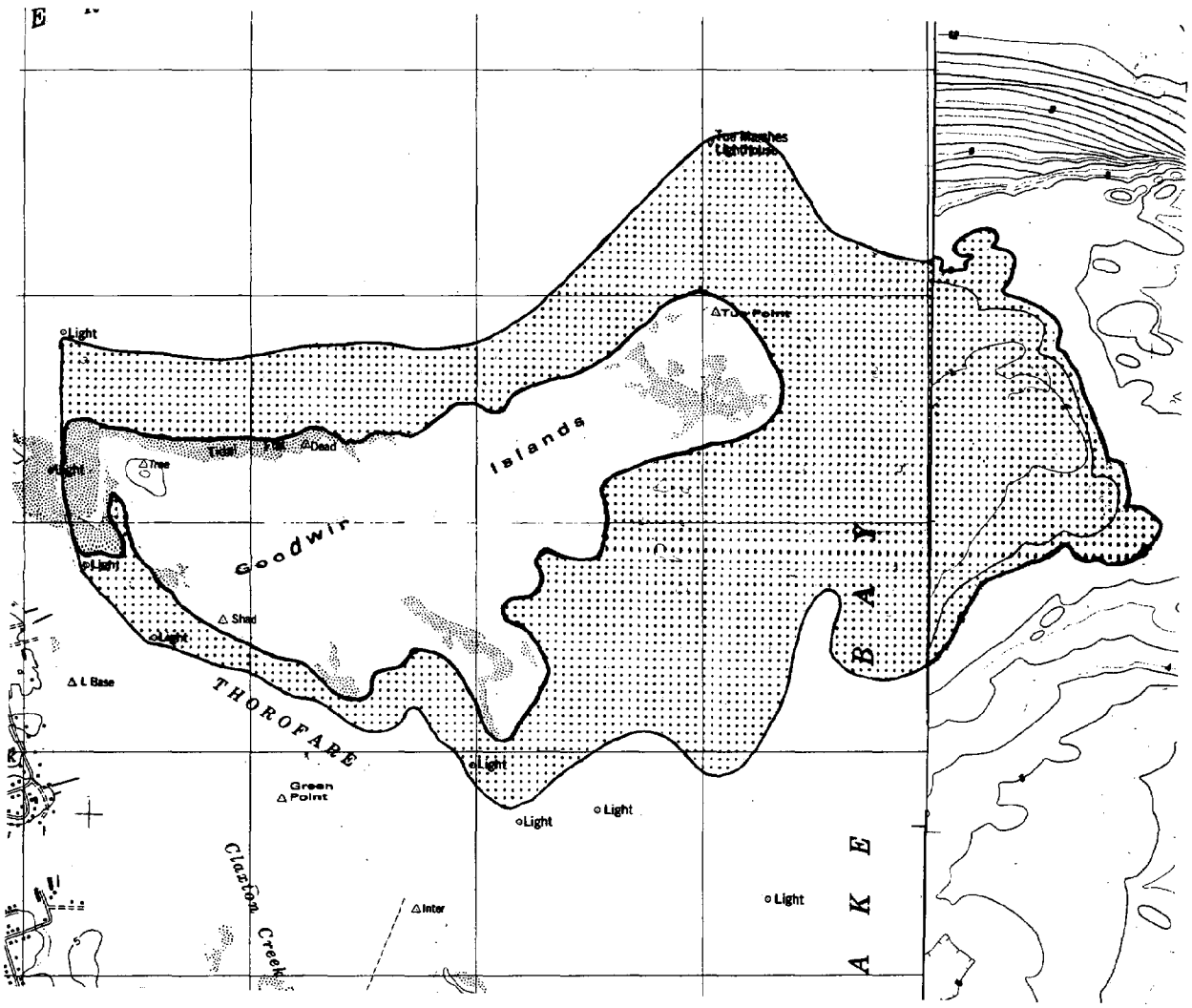
Nearby residential and urban centers include Newport News (7 mi/11.2 km), Poquoson (10 mi/11.6 km), Gloucester Point (12 mi/19.2 km), Williamsburg (13 mi/20.8 km), Hampton (16 mi/24 km), and Norfolk (21 mi/33.6 km).

CATLETT ISLANDS The Catlett Islands are located approximately 19 nmi upstream from the York River mouth and about 32 nmi downstream from West Point. The islands are offshore of Timberneck Farm between Timberneck and Cedarbush creeks on the north shore of the York River (Figure 5). They are separated from the farm by tidal wetlands and creeks. Timberneck Farm is one of the largest working family farms and remaining King's Grant parcels on the York River in Gloucester County. The islands are named for the Catlett family, which has owned Timberneck Farm since 1793. Nearby residential and urban centers include Gloucester Point (9 mi/14.4 km), Gloucester (10 mi/16 km), Mathews (23 mi/36.8 km), Newport News (23 mi/36.8 km), and West Point (26 mi/41.6 km).

The Catlett Islands are accessible primarily by boat. They are located approximately 5 nautical miles from VIMS. There are two piers on the islands; one is unusable and the other one is reserved for private (hunting) use. Other permitted visitors must moor their boats and wade ashore. The islands can be reached only on a flooding tide. Visitors are advised to leave before low tide, lest they become stranded by the ebbing tide.

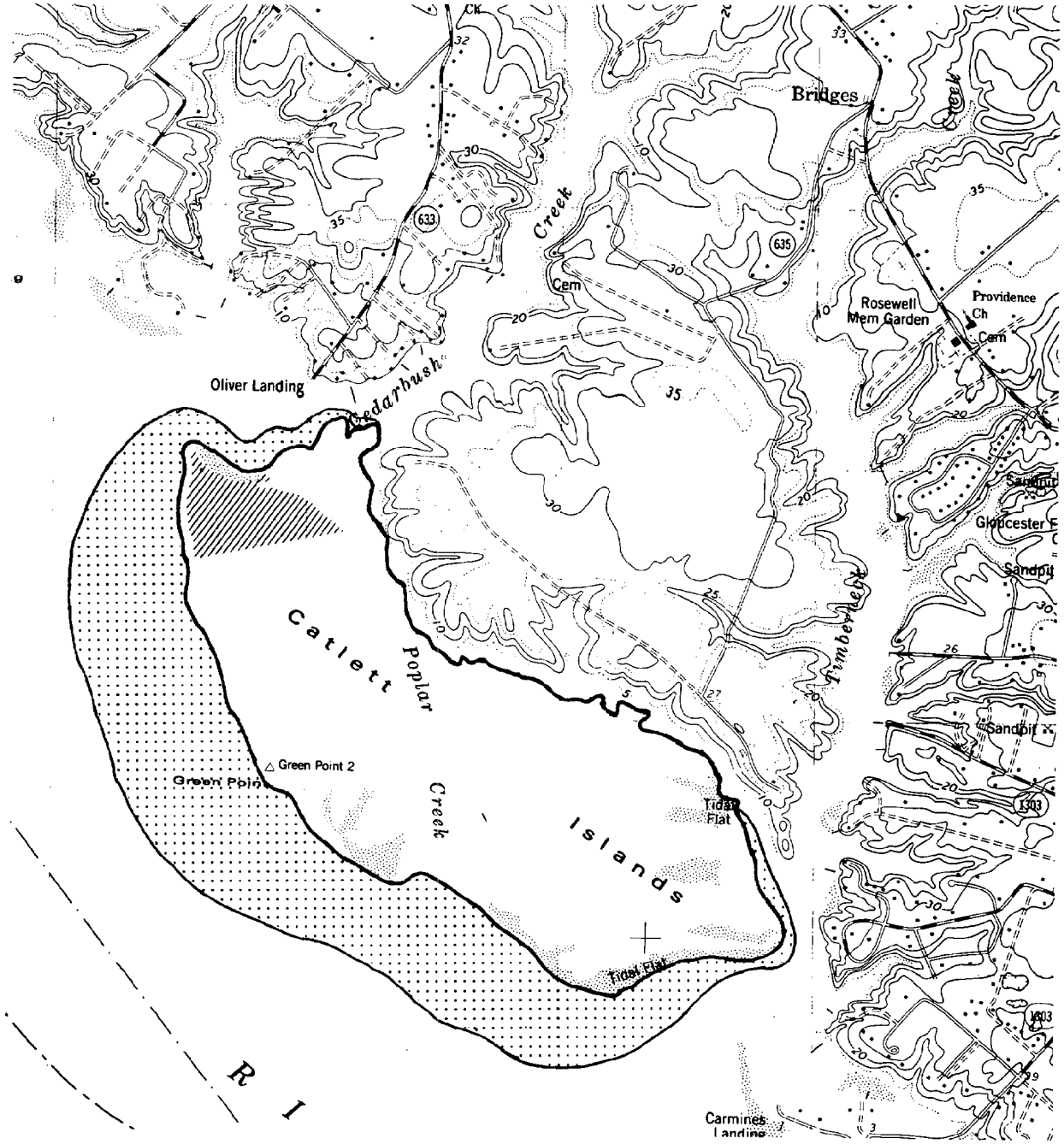
By land, there is limited entry through Timberneck Farm, and the landowners' permission is required. The farm road is used by farm vehicles, and the only areas suitable for parking are narrow filter strips alongside cultivated fields and pasture. To reach the islands, one must walk between crop rows in cultivated fields, through dense forest, and across tidal marshes and creeks that are only navigable with hip boots at low tide.

Figure 4
GOODWIN ISLANDS
Poquoson West, Va. 7.5-minute series (topographic)



Research Core Area
Buffer Area

Figure 5
CATLETT ISLANDS
Clay Bank, Va. 7.5-minute series (topographic)



Research Core Area

Buffer Area

Excluded from CBNERRS-VA

TASKINAS CREEK Taskinas Creek is located on the south shore of the York River in James City County about 24 nmi upstream from the river mouth, 12 nmi upstream from VIMS, and 8 nmi downstream of West Point (Figure 6). The creek has its source near the small town of Croaker, located 6 mi north of Williamsburg. The creek flows in northeast, covering a distance of about 3 nmi. Much of its watershed is located within York River State Park.

Taskinas Creek can be reached from Interstate 64 by taking Exit 231B (Croaker Exit) to Route 607. On Route 607, one turns right on Route 606 and follows signs to the entrance of York River State Park. The park is located near greater Richmond (39 mi/62.4 km), Hampton-Newport News (30 mi/48 km), and the rural counties of New Kent, Charles City, King William, King and Queen, Mathews and Gloucester.

SWEET HALL MARSH Sweet Hall Marsh is located on the Pamunkey River in King William County (Figure 7). The Pamunkey River converges with the Mattaponi River at West Point to form the York River. Sweet Hall Marsh encompasses one of eight major marshes and swamps created by meanders of the Pamunkey River above White House. It is located approximately 45 nmi from the mouth of the York River and 19 nmi upstream from West Point. By water, Sweet Hall Marsh is approximately 34 nmi from VIMS. By land, it is about 7 mi/11.2 km from West Point, 34 mi/54.4 km from Williamsburg, 45 mi/72 km from Gloucester Point, and 47 mi/75.2 km from Richmond.

Access to Sweet Hall Marsh is possible only by water. Tacoma Hunting and Fishing Club maintains a private road, a boathouse and a clubhouse on the uplands above Sweet Hall Marsh. The club allows VIMS to keep a storage trailer on site and to use an unimproved ramp adjacent to the boathouse for launching Jonboats and canoes. Research vessels moor in the thoroughfare.

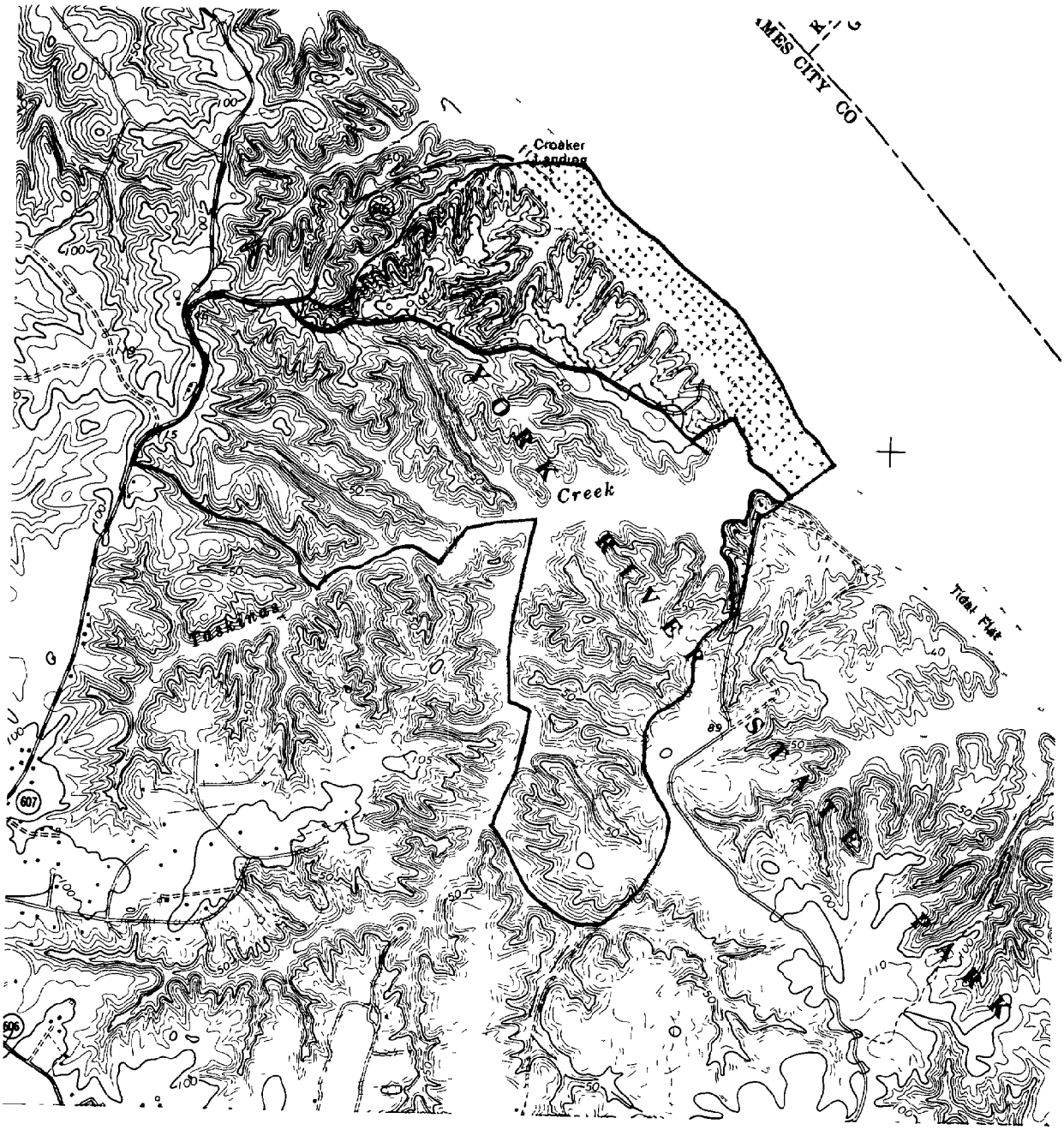
THE NATURAL ENVIRONMENT

HYDROLOGY AND CLIMATE

GOODWIN ISLANDS Circulation patterns around the Goodwin Islands are strongly influenced by the discharge of the York River and the wind patterns in Mobjack Bay and the Chesapeake Bay. Salinities are similar to those of adjacent Bay waters (16-22 ppt), and nearshore waters are shallow and clear enough to permit light penetration for submerged aquatic vegetation growth. Surface water temperatures range from 5.6°C to 26.8°C (Brooks, 1983). Water quality is categorized as fair, although in general it is in better condition than that of the other major western shore tributaries (Spells and Frazer, 1984). No known water toxicity problems exist in this stretch of the York River system (EPA, 1983a), but some areas are moderately enriched due to nutrients (EPA, 1983b). The Goodwin Islands are located in an area of particular concern for low dissolved oxygen levels; however, these conditions are attributed to natural consequences of thermal and salinity stratification rather than to pollution (Hyer, 1977). Seasonal ranges for dissolved oxygen are 1.8-12.0 mg/l (Brooks, 1983).

CATLETT ISLANDS The hydrology of the lower estuarine reaches of the York River system is strongly influenced by tides. VIMS Slack Water Station No. 19.21 is located directly offshore of the Catlett Islands, and data recorded there from 1970 to 1980 are used to characterize hydrologic conditions in the vicinity (Brooks, 1983). Surface water temperature ranges from 5.4°C to 27.4°C, and dissolved oxygen concentrations range from 4.2 to 14.0 mg/l (Brooks, 1983). Salinities range from 14 to 18 ppt in the fall and from 8.2 to 12 ppt in the spring, indicative of mesohaline conditions. The salinity gradient tends to be cross-stream rather than vertical, resulting in a westerly net advective flow of water along the northern shore of the lower York River in front of the Catlett Islands and an easterly net flow along the southern shore.

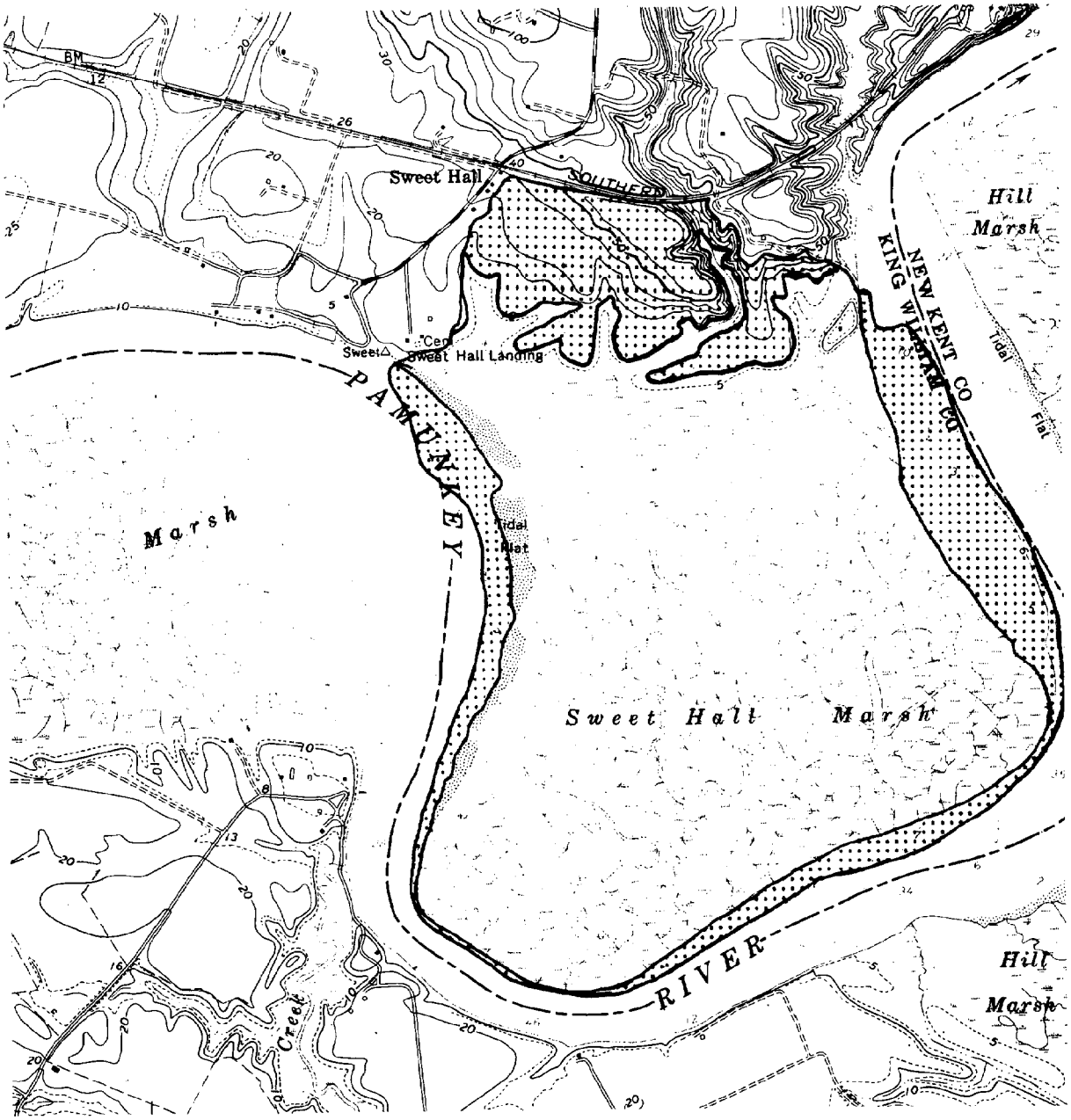
Figure 6
TASKINAS CREEK
Gressitt, Va 7 5-minute series (topographic)



Research Core Area

Buffer Area

Figure 7
SWEET HALL MARSH
New Kent, Va. 7.5-minute series (topographic)



The York River channel lies approximately one nautical mile off the Catlett Islands. Water depths in the channel range from 30 feet to 60 feet. The channel is used by large naval ships in transit to and from Cheatham Annex and Camp Peary, tugboats with barges in transit to and from West Point, commercial fishing boats, sportfishing boats, research vessels, the U.S. Coast Guard, and the Virginia Marine Resources Commission marine patrol.

The York River is fairly wide at the Catlett Islands. Fetches are 20 miles from the northwest; 4 miles from the west; 2 miles from the southwest; and 2.5 miles from the south. The only storms and winds to directly attack the Catlett Islands shoreline are those from the northwest through the southeast during fall, winter and early spring. Summer regional winds generate wave activity that also attacks the shoreline, although with less force (Anderson et al., 1976).

The lower York River shoreline is incised by small tidal creeks. Of these, Timberneck Creek flows into the York River on the eastern side of the Catlett Islands and Cedarbush Creek enters the river on the western side. Timberneck Creek is approximately 4.1 miles long and drains 3.83 square miles, and Cedarbush Creek is 3.7 miles long and drains 2.57 square miles (Finkelstein and Hardaway, 1980). Poplar Creek, another small creek, bisects the Catlett Islands into eastern and western lobes. Meanders from the creeks extend into the marshes between the ridges of the islands.

Overall, water quality conditions are good in the lower York River (EPA, 1983). A Chesapeake Bay Program water quality monitoring station is located off the Catlett Islands. Recent data (1985) suggest that non-point sources are the major contributors of nitrogen and that point sources are the major contributors to phosphorus in the lower York (COE, 1987); however, there are no point dischargers near the Catlett Islands. Increased runoff, associated with groundcover removal and chemical contamination from lawn, garden and farm fertilizer, and pesticide use are implicated in water quality problems in Gloucester County (Anderson et al., 1976).

Condemnation of shellfish growing areas is a water quality issue around the Catlett Islands, but conditions are improving. Water samples, collected in Timberneck and Cedarbush creeks by the Virginia Bureau of Shellfish Sanitation, often have been rated unsatisfactory because of fecal coliform bacterial contamination, primarily from deficient residential septic systems, and shellfish beds were closed to harvest. Through the coordinated efforts of the Shellfish Enhancement Task Force and through stepped-up enforcement efforts by the State Health Department, some areas in Timberneck and Cedarbush creeks have been reopened as residential sanitation system violations have been corrected (COE, 1987).

TASKINAS CREEK The mouth of Taskinas Creek is located midway between the Virginia Institute of Marine Science slack water stations 36.95 and 47.62 (Brooks, 1983) and almost directly onshore of a Chesapeake Bay Program water quality and benthic sampling station (COE, 1987). Data from these sampling stations are used to characterize the hydrology and water quality of the transition zone of the York River.

The fetch across the river from the northeast is 1.5 to 2 nmi. Fetches from the north and east exceed 3 nmi. The York River channel is used for the shipping of pulpwood and pulpwood products to and from West Point.

Water temperature data for 1970-1981 show a seasonal pattern that follows the air temperature pattern through the year. Average minimum winter surface water temperatures are between 3°C and 6°C. Water temperatures increase from 10°C to 19°C through the spring, reaching maximum temperatures around 26°C in August. Water temperatures decline throughout the fall (Brooks, 1983).

Salt water intrudes from the Chesapeake Bay beyond Taskinas Creek to the region around West Point. Salinities near Taskinas Creek from 1970 to 1980 ranged from 9 to 13 ppt in late summer, fall, and winter and from 3 to 7 ppt in spring and early summer (Haven et al., 1981; Brooks, 1983). Both ranges indicate transitional conditions and

reflect seasonal freshwater input. Salinities within Taskinas Creek range from river salinities at the creek mouth to almost 0 ppt in the non-tidal headwaters.

Water quality in the transitional zone of the York River is satisfactory. Ammonium concentrations and nitrite/nitrate concentrations are low year-round due to dilution by high-salinity Chesapeake Bay water, which is typically low in these constituents. Organic nitrogen concentrations are high with a maximum in the spring. Orthophosphate concentrations are low in the spring and elevated in the fall, while particulate phosphorus varies seasonally, usually in conjunction with high stream flows. Silica concentrations decrease from West Point to the mouth of the York River due to estuarine dilution (Virginia Water Control Board, 1989).

Dissolved oxygen levels range from good to poor (Sturm and Neilson, 1977). Fecal coliform bacteria levels are sufficiently high to force condemnation of shellfish beds in Taskinas Creek (State Water Control Board, 1980). Heavy metal concentrations are considerably greater than natural pristine levels in the upper York River above Taskinas Creek; however, concentrations of copper, cadmium and zinc in the tissues of oysters of the upper York River in the vicinity of Taskinas Creek are consistent with metal concentrations in oysters sampled elsewhere within the Chesapeake Bay (Huggett, 1977).

The York River is impacted by point-source discharges at West Point from Chesapeake Corporation (a large producer of pulp, paper, and paperboard), a wood veneer plant, and a grain and fertilizer business. No other towns or large industrial facilities are located in the transitional zone of the river, although residential development is increasing.

SWEET HALL MARSH The Pamunkey River is oligohaline from its mouth to the eastern side of Sweet Hall Marsh and is tidal fresh from this point to the head of the tidal bore. A 20-year salinity record for the Pamunkey River shows a range of 0.0 to 5.0 ppt with an average of 0.5 ppt at Sweet Hall Marsh (Brooks, 1983).

The Pamunkey River at Sweet Hall Marsh is narrow, averaging 1,400 feet in width, but at least 12 feet deep (Figure 8). The predominant wind fetch at Sweet Hall Landing is from the south and covers a distance of 1.5 miles. Exposure to wind-generated waves is small due to the narrow width and meandering nature of the river.

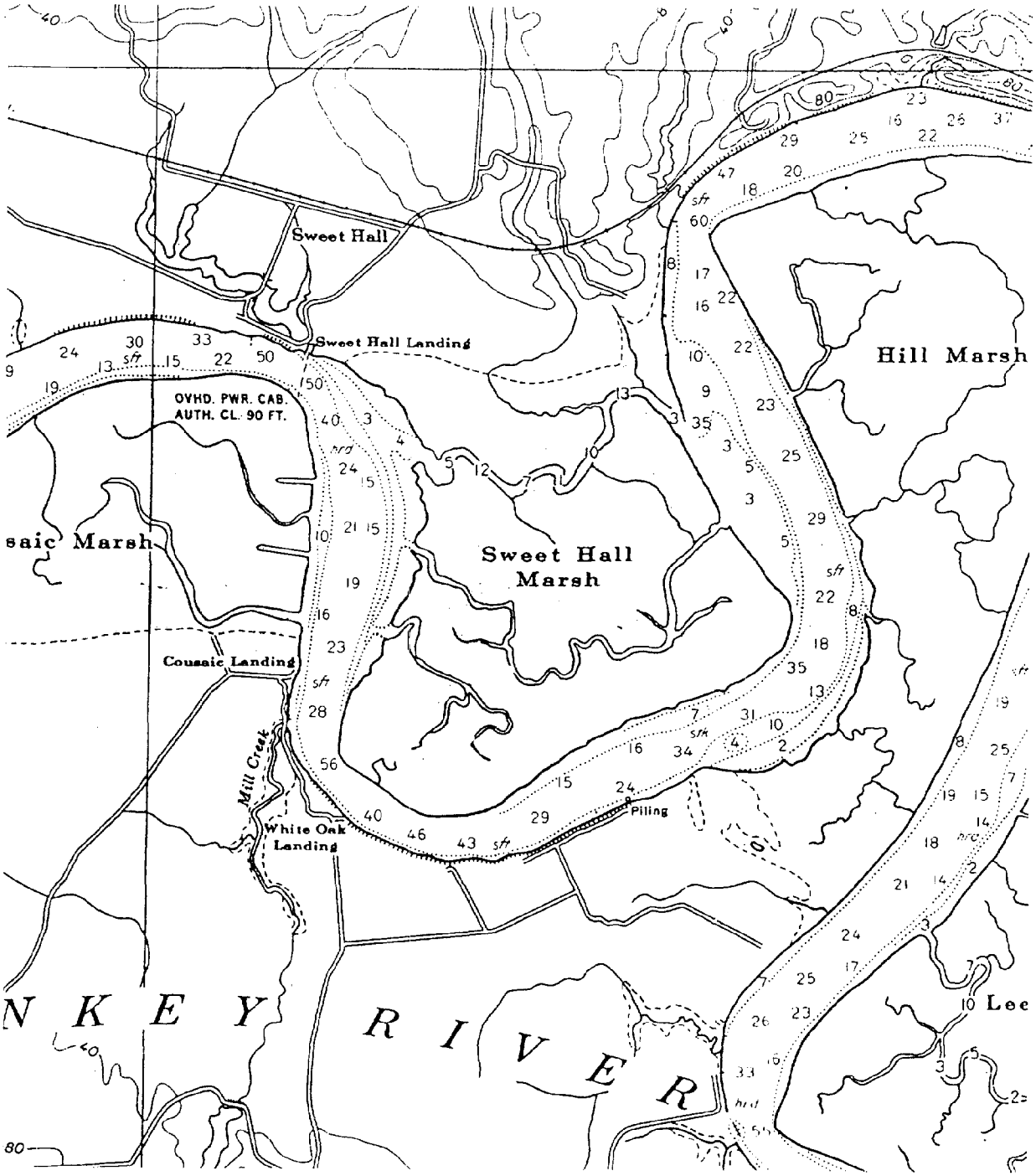
Mean tidal range in the Pamunkey River gradually increases from West Point to Sweet Hall Marsh due to basin morphology. At Sweet Hall, the range is 90 cm (NOAA, 1987), and much of the marsh is flooded at high tide. Flood hazard to the fastlands is low and non-critical, primarily because of the marsh, which absorbs flood waters and reduces flood peaks. The marsh is bisected by a thoroughfare and incised by several meandering tidal creeks.

Average quarterly water temperatures at Sweet Hall Marsh are 5°C in winter, 20.5°C in spring, 26°C in summer, and 13°C in fall. The greatest rate of temperature change occurs during the spring quarter; autumn temperatures decrease more gradually.

The Pamunkey and Mattaponi rivers are the most pristine rivers on the East Coast. Unlike other Virginia rivers, the Pamunkey and Mattaponi do not have major urban or industrial developments at the fall line. Pressure is mounting, however, for major residential/commercial developments and water diversion projects involving these river basins.

The tidal freshwater portion of the Pamunkey River contains moderate levels of nutrients. Trend analysis indicates that the nitrogen compound levels are increasing (EPA, 1983). Dissolved oxygen levels range from 4.0 to 12.4 mg/l, with the lowest levels exhibited in the summer. Heavy metal concentrations in sediments in the lower Pamunkey River and upper York River are considerably greater than natural pristine levels (EPA, 1983). The source of the metal contamination is believed to be abandoned pyrite mines on Contrary Creek (R.J. Huggett, VIMS, pers. comm.). At West Point, water quality in the Pamunkey River is impacted by point-source discharges from a kraft paper mill and a veneer plant.

Figure 8
SWEET HALL MARSH
NOAA Nautical Chart 12243, Pamunkey and Mattaponi Rivers



GEOLOGY AND SOILS

GOODWIN ISLANDS The geomorphology of the Goodwin Islands consists of a ridge-and-swale topography that developed from a series of beach ridges deposited during a late Pleistocene regression of the sea (Leonard, 1986). Beach ridges are sandy and gravelly features that may develop during storms or during continuous spring-tide high waters. The stratigraphic sequence of sediments encountered on the Goodwin Islands is Yorktown Formation (Pliocene), Tabb (Pleistocene), Poquoson (Pleistocene), and Holocene. Vegetation patterns reflect the topography, with forests on the ridges and marshes in the swales.

The shape and relief of the islands are being modified by natural and human-induced processes. The Goodwin Islands complex is eroding along its northern (York River) shore and prograding bayward (into the Chesapeake Bay). The deposition of dredge material in 1951-1952 has acted to increase the mass of the main island. Erosional patterns around the perimeter of the islands, however, show a net loss of mass. Approximately 104 acres of marsh were lost between 1854 and 1954 (Anderson et al., 1975), and islands to the southeast have been submerged in the past 400 years (Leonard, 1986).

In general, the predominant soil types on the Goodwin Islands may be classified as Tomotley-Altavista-Dragston. This soil association is described as being deep, poorly drained to moderately well drained to somewhat poorly drained soils that dominantly have a loamy subsoil and are almost level (Figure 9 and Table 1).

CATLETT ISLANDS The lower York River shoreline above Gloucester Point is oriented northwest-to-southeast. The Catlett Islands lie in a stretch of the lower York River characterized by moderately low to low fastland and shorelines with extensive, fringed or embayed marshes (Anderson et al., 1976).

The geomorphology of the Catlett Islands is one of ridge-and-swale topography (Finkelstein and Hardaway, 1988). This topography is analogous to the ridge-and-swale systems described for Poquoson (Gray, 1985), Plumtree Island (Johnson, 1972), and the Goodwin Islands (Leonard, 1986) and for various locations on the Eastern Shore of the Chesapeake Bay (Mixo, 1985). Sea level change is the most frequently cited explanation for the evolution of ridge-and-swale systems. Current theory suggests that the ridges result from the deposition of beach ridges parallel to the shore, marking successively lower stands of sea level as the shoreline receded about 65,000 years ago during the late Pleistocene glaciation (Leonard, 1986; Finkelstein and Hardaway, 1988). Following the deposition of sediments, the area became emergent and covered by vegetation. When the last glaciation period came to an end, sea level began to rise. In the past 5,000 years, the rise in sea level has flooded the low-lying swales between the Catlett Islands and, more recently, altered the configuration of the islands through erosion.

The complex arrangement of soils on the Catlett Islands is presented in Figure 10 and described in Table 2. The westernmost portion of the soil complex is dominated by Sulfaquents which are poorly drained, almost level (at an elevation slightly higher than sea level), and flooded daily by tidal water. The higher ridges are dominated by the Ochraquults-Haplaquepts complex, which is almost level and poorly drained and consists of a fine grayish-brown sandy loam. Surface runoff is slow and the surface layer and subsoil are extremely acidic. A seasonal water table is found at the surface and to a depth of 12 inches in winter and spring and to a depth of 30 inches throughout the remainder of the year. The easternmost portion of the soil complex is dominated by large areas of Eunola fine sandy loam which is almost level and moderately well drained. Surface runoff is slow and soils are acidic. The water table is found at a depth of 18-30 inches in winter and spring. Fluvaquents, which are saline and found along creeks, and Lumbee, which is an almost-level, poorly drained, acidic sandy loam, are found throughout the area.

Sea level rise and waves generated by local winds are the dominant agents of erosion in

Figure 9
GOODWIN ISLANDS SOILS MAP

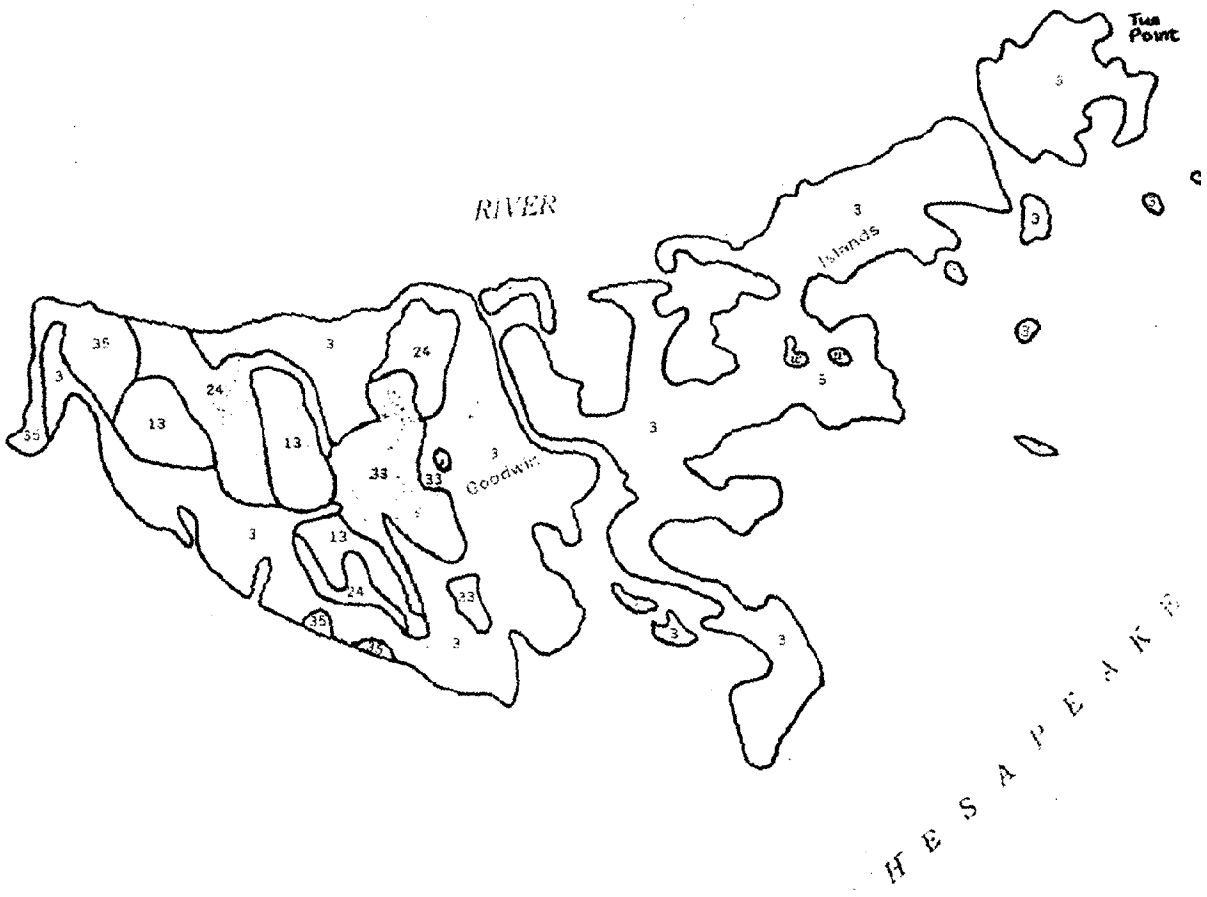


Table 1
GOODWIN ISLANDS SOILS

Soil Unit	*Soil Type*	*Description*
3	Axis very fine loam	This soil is very poorly drained and is on sandy loam tidal marshes. The permeability is moderate and the available water capacity is high. Surface runoff is very slow for this soil type, the organic content is high, and the natural fertility is medium.
13	Dragston sandy loam	This soil type is deep, nearly level, and somewhat poorly drained. The permeability is moderately rapid and the available water capacity is low. Surface runoff is slow and the erosion hazard is slight. The soil is low in organic matter content and low in natural fertility. The subsoil has low shrink-swell potential. A high water table is between the surface and a depth of 1-2.5 ft. in winter and spring.
24	Nimmo fine sandy loam	This soil is deep, nearly level, and poorly drained. Permeability is moderate in the upper layers of the soil and moderately rapid in the substratum. Available water capacity is moderate and surface runoff is slow. The erosion hazard is slight. The soil is moderate in organic matter content and low in natural fertility. The subsoil has low shrink-swell potential. A high water table is between the surface and a depth of 0.5 ft. in winter and spring.
33	Tomotley fine sandy loam	This soil is deep, nearly level and poorly sandy loam drained. The permeability is moderate to moderately slow and the available water capacity is moderate. Surface runoff is slow. The erosion hazard is slight and the subsoil has a low shrink-swell potential. The soil is low in organic matter content and natural fertility.
35	Udorthents, loamy	This unit consists of deep, well drained. The permeability ranges from moderately rapid to slow. The available water capacity ranges from low to high, depending on the texture and gravel content of the material. Surface runoff ranges from very slow to rapid. The erosion hazard ranges from slight to severe.

the lower York River. The magnitude of shoreline erosion in the vicinity of the Catlett Islands is moderate to severe. Historically, the rate of shoreline retreat in the stretch of the York River between Blundering Point and the southern extent of the Carmine Islands (including the Catlett Islands area), has been approximately 0.7 feet per year (the maximum rate along the York River in Gloucester County has been 1.9 feet per year). Based on a comparison of shoreline positions between the 1850s and 1940s and an assessment of 1930s and 1973 aerial photography, Anderson et al. (1976) estimated that the Catlett Islands have lost approximately 56 acres in the past 100 years. At the same time, the York River shore in Gloucester County lost 442 acres. This indicates a loss of approximately four acres per mile of shoreline in the past century. Erosion is especially severe on the western end of the Catlett Islands, where it has claimed several meters of shoreline in recent years, toppled trees, and undermined the foundation of a summer cottage.

TASKINAS CREEK The shoreline along the transitional zone of the York River trends from northwest to southeast. The shoreline is mostly low with some bluffs and somewhat rugged uplands. Erosion rates range between

Figure 10
CATLETT ISLANDS SOILS MAP

Table 2
CATLETT ISLANDS SOILS

Soil Unit	*Soil Type*	*Description*
1B	Alaga loamy sand, 0- to 4-percent slopes	This soil is nearly level or gently sloping. It is well drained and somewhat excessively drained. It is found on broad flats and terraces at an elevation of less than 50 ft. Permeability is rapid and available water capacity is low. Surface runoff is slow and erosion hazard is slight.
6	Eunola fine sandy loam	This soil is nearly level and moderately well drained. It is on broad flats throughout the county. Permeability is moderate and available water capacity is moderate. Surface runoff is slow and the erosion hazard is slight. The soil has a seasonal high water table at a depth of 1.5-2.5 ft. during winter and early spring.
8	Fluvaquents, saline	These soils are nearly level and poorly drained. They are along the lower courses of small streams next to areas of saltwater and are frequently flooded by very high tides. Permeability is moderately slow to slow and available water capacity is moderate. Surface runoff is very slow. The water table is at a depth of 1 ft. year-round.
9D	Hapludults, steep	These soils are moderately steep to steep and are well drained or moderately well drained. They are in long and winding areas on side slopes of streams. Seeps and springs are common at the lower edges of the slopes. The permeability is moderate to slow and available water capacity is moderate. Surface runoff is rapid, erosion hazard is very severe, and there is a moderate shrink-swell potential.
10	Johns sandy loam	This soil is nearly level and moderately well drained. The permeability is moderate and available water capacity is moderate. Surface runoff is slow, erosion hazard is slight and the water table is at 1.5 to 3 ft. during the winter and early spring.
11	Johns variant loamy sand	This soil is nearly level and moderately well drained. It is on broad flats at elevations of less than 20 ft. The permeability is moderately rapid and available water capacity is low. Surface runoff is slow and erosion hazard is slight. A seasonal water table is at a depth of 1-2 ft. during winter and early spring.
12B	Kalmia sandy loam, 0- to 4-percent slopes	This soil is nearly level and gently sloping. It is well drained and found on long, narrow areas at an elevation of less than 20 ft. The permeability is moderate, and available water capacity is moderate. Surface runoff is medium, and erosion hazard is slight.
14B	Kenansville loamy fine sand, 0- to 4-percent slopes	This soil is nearly level, gently sloping, and well and well drained. The permeability is moderately rapid, available water capacity is low, and surface runoff is slow. Threat of erosion is slight, but soil blowing is a hazard in unprotected areas.
16	Lumbee sandy loam	This soil is nearly level and poorly drained. The permeability is moderate, available water capacity is low, and surface runoff is very slow. The erosion threat is slight. A seasonal water table is between the surface and a depth of 1 ft. during winter and early spring.

Table 2, continued
CATLETT ISLANDS SOILS

Soil Unit	*Soil Type*	*Description*
17	Lumbee variant sandy loam	It is nearly level, poorly drained, and found on broad flats at elevations less than 10 ft. The permeability is moderately rapid, available water capacity is low, and surface runoff is very slow. Erosion threat is slight. There is a seasonal water table between the surface and a depth of 1 foot during winter and early spring.
21	Ochraquults-Haplaquepts complex	This complex consists of nearly level, poorly drained, and somewhat poorly drained soils that are so intermingled that it is not practical to map them separately. The complex is usually found at an elevation of more than 20 ft. The complex is about 60-percent Ochraquults, 30-percent Haplaquepts, and 10-percent other soils. The overall permeability is moderate to slow, surface runoff is very slow, and the erosion hazard is slight. A seasonal water table is between the surface and a depth of 1 ft. during winter and spring and is mainly at a depth of 30-40 in. for the rest of the year.
23	Oiser loamy fine sand	This soil is nearly level and poorly drained. It is in long, narrow areas at the base of escarpments and near areas of water. The permeability is rapid, and available water capacity is low. Surface runoff is very slow and erosion hazard is slight. A seasonal water table is between the surface and a depth of 1 ft. during winter and spring.
24B	Pactolus loamy loamy sand, 0- to 4-percent slopes	This soil is nearly level and very gently sloping and is moderately well drained. It is on terraces at an elevation of less than 50 ft. The permeability is rapid, available water capacity is low, and surface runoff is slow. The erosion hazard is slight, but soil blowing is a moderate hazard in unprotected areas. A seasonal high water table is at a depth of 1.5-2.5 ft. during winter and early spring.
25	Pamlico and Portsmouth soils	This unit consists of nearly level, very poorly drained soils in depressional areas. The two types of soils are mapped together because they have no major differences in use and management. The permeability of the soils is moderate, available water capacity is low, surface runoff is very slow, and water is ponded on the surface in some areas. The soils have a seasonal water table between the surface and a depth of 1 ft. from winter to early summer and at a depth of 2-3 ft. for the rest of the year.
27C	Psamments-Hapludults complex	This complex consists of sloping, well-drained and moderately well-drained soils that are so intermingled that it is not practical to map them separately. The complex is in long, narrow areas along drainageways and streams. Psamments make up about 50 percent of the complex, Hapludults about 40 percent, and other soils about 10 percent. The overall permeability of the major soils of this complex is moderately slow to rapid, and available water capacity is low to moderate. Surface runoff is medium to rapid. The erosion hazard is

severe. The soil has a low to moderate shrink-swell potential.

Table 2, continued
CATLETT ISLANDS SOILS

Soil Unit	*Soil Type*	*Description*
27D	Psamments-Hapludults complex, steep	This complex is moderately steep to steep, well drained and moderately well drained. It is comprised of about 60 percent Psamments, 40 percent other soils. The permeability of the major soils is moderately slow to rapid, and available water capacity is low to moderate. Surface runoff is rapid. The erosion is very severe. The underlying layers have a low to moderate shrink-swell potential.
29A	Suffolk fine sandy loam, 0- to 2-percent slopes	This soil is nearly level and well drained. It is on broad flats at an elevation of more than 20 ft. The permeability is moderate, and available water capacity is moderate. Surface runoff is slow. The erosion hazard is slight.
29B	Suffolk fine sandy loam, 2- to 6-percent slopes	This soil is gently sloping and well drained. It usually is found in broad areas at an elevation of more than 20 ft. The slope's permeability is moderate, available water capacity is moderate, and surface runoff is medium. The erosion hazard is moderate.
29C	Suffolk fine sandy loam	This soil is sloping and well drained. It is in long, narrow areas on escarpments througout the county. The permeability is moderate, and available water capacity is moderate. Surface runoff is medium to rapid. The erosion hazard is severe.
30	Sulfaquents, frequently flooded	These soils are nearly level and are poorly drained and very poorly drained. They are flooded mainly along areas of saltwater at an elevation slightly above sea level and are flooded daily by tidal water.

1.1 and 2.0 feet per year (Hobbs et al., 1975). The shoreline is mostly composed of marshes grading into swamps.

The stratigraphic sequence near Taskinas Creek is composed of the Potomac Group (Cretaceous), Pamunkey Group (Paleocene, Eocene and Oligocene), Chesapeake Group (Miocene and Pliocene), and Pleistocene and Holocene sediments. These deposits consist of clay, silt, sand and gravel with variable amounts of shell material. The coastal plain is underlain by sedimentary deposits, thin, unconsolidated sediments, and hard rock called "basement" (Berquist, in prep.). The Cretaceous sediments are mainly continental in origin and alternate sand and clay layers. These alternating depositional sequences are attributed to fluvial-deltaic processes. Tertiary sediments of marine origin overlie the Cretaceous deposits, and a thin layer of Pleistocene sediments is found at the surface.

The geologic units exposed at the surface in the Taskinas Creek watershed include the Eastover and Yorktown of the Chesapeake Group (Figure 11). The Eastover and Yorktown are layers of fossiliferous marine or tidal-flat sands and silts formed on a marine shelf that crops out in deep valleys of Taskinas Creek. The Eastover Formation runs along the marsh boundary and is composed of quartzose, calcite and aragonite, micas, pyrite, glauconite, selenite, and heavy minerals in small amounts. The Yorktown Formation crops out in valleys and is exposed in bluffs along the York River. In steep areas, normal downslope wasting is occasionally accelerated by storms or flooding, exposing the formation. The Bacons Castle, the dominant geologic type at Taskinas Creek, comprises intertidal and marine silt, sand, and clay overlying a thin, pebbly, coarse sand. This unit is iron-stained and locally cemented by iron and

Figure 11
TASKINAS CREEK PRELIMINARY GEOLOGIC MAP

manganese nodules. The Shirley Formation is found along the upland ridges adjacent to the York River and is composed of quartz, sandstone, granite, gneiss and schist. Peat layers exist in thin beds within the sands and clays.

The Holocene deposits in the region consist of estuarine, marsh, swamp and alluvial sediments. Swamp sediments (the peat layer) underlie most of the well-established swamps and are characterized by peat or organic-rich silt and clay. Marsh sediments are found beneath brackish and freshwater marshes along Taskinas Creek. Plant deposits are at least 34 feet thick in some places. Alluvium, or the fluvial sand layer, crops out along upland streams and beneath estuarine silts. This gravelly sand was deposited in the channel of streams or along beaches during the Holocene and Late Pleistocene. The soils are described in Figure 12 and Table 3.

SWEET HALL MARSH The tidal freshwater portion of the Pamunkey River is oriented east-west and is characterized by large sweeping river meanders vegetated by freshwater marshes and forested swamps. The wetlands reduce erosion rates along the Pamunkey River shoreline. Any erosion that does occur takes place on the outside of the river bends where there is fastland not protected by wetlands. In times of unusually high water associated with floods or storms, the fastlands in the apex of the river bends are particularly susceptible to erosion from flood waters. Elevated lunar tides and enhanced boat wake are additional sources of wave energy that undercuts and erodes the fastlands. Reduction of natural vegetation on fastlands also increases erosion because it allows a greater percentage of rainwater to flow over the bank or cliff face, accelerating slumping and shoreline retreat (Hobbs et al., 1975a).

Eustatic sea level rise in the area of Sweet Hall Marsh is 1.5 mm per year. Compounding this rise is localized land subsidence at rates of 2 to 3 mm per year. The subsidence occurs in a cone of depression centered around West Point and results from the collapse of the water-bearing formation caused by groundwater withdrawals by the papermaking industry (Weigmann and Kroehler, 1988). Overall, relative sea level rise at Sweet Hall Marsh is between 3.5 and 4.5 mm per year.

The geology of Sweet Hall Marsh is part of the fluvial depositional system of the Coastal Plain of Virginia and is that of a "young" marsh, according to Odum's (1984) description of the developmental stages of tidal freshwater marshes. Sweet Hall Marsh is divided into four general geomorphic zones: creek bank, levee, low marsh flat, and high marsh/upland edge (Frey and Basan, 1986). The creek bank is a wave-cut feature located along the edge of the marsh and is the most dynamic and tidally influenced region (Reay, 1989). The creekbank grades sharply to a levee over an average distance of 8 m. The backside of the levee gradually grades into an expansive low marsh flat bordered by a narrow transition zone. The transition zone (or high marsh/upland edge) consists of two components: a steep eroding sandy bank leveling into an agricultural field, and a gently sloping wetland transition to bottomland hardwood forest.

Ledwin (1988) describes sedimentation and its role in Sweet Hall Marsh. Most sediment deposition to the marsh occurs during the summer as plants trap sediment and slow the water velocity, allowing suspended particles to settle out. When the plants are rapidly growing, large quantities of nutrients and organic matter are deposited to the marsh. In winter, ice scour and storm erosion export nutrients from the marsh, although this generally occurs only in the less vegetated regions of the marsh.

Preliminary information on the general soil parameters at Sweet Hall Marsh is derived from a preliminary soils map for King William County (Figure 13) and a recent study on subsurface hydrology (Reay, 1989). The creekbank and low marsh flat are composed primarily of a silt-clay mixture of riverine origin. The levee region has a slightly higher percentage of silt content, and the high marsh/upland edge region has a large sand component. Water content of soils is highest in the high marsh/upland edge region where

Figure 12
TASKINAS CREEK SOILS MAP

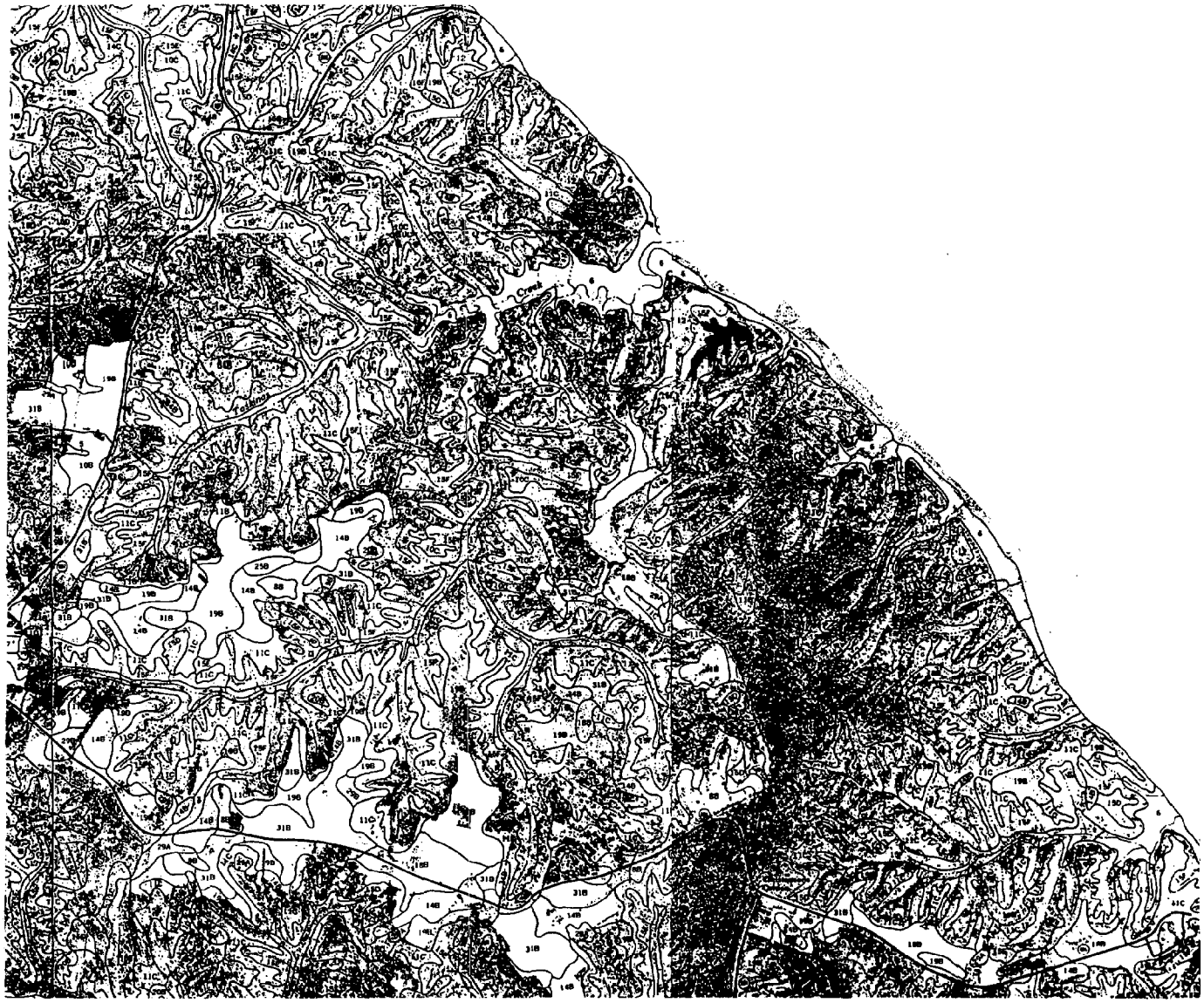


Table 3
TASKINAS CREEK SOILS

Soil Unit	*Soil Type*	*Description*
6	Bohicket muck	This soil is deep, nearly level and very poorly drained. It is found on tidal marshes and is commonly long and winding. It has a low surface shrink-swell potential. Erosion is moderate and available water capacity is high.
8B	Caroline fine sandy loam, 2- to 6-percent slopes	This soil is deep and gently sloping. It is found on upland ridges and side slopes. It has a low to moderate shrink-swell potential. Erosion is a moderate hazard, and water capacity is moderate.
10B	Craven fine sandy loam, 2- to 6-percent slopes	This soil is deep and gently sloping. It is found on broad upland flats and narrow to broad ridges and side slopes. It has a low shrink-swell potential. Erosion is a moderate threat and the water capacity is moderate.
10C	Craven fine sandy loam, 6- to 10-percent	This soil is deep and strongly sloping. It is found onnarrow to medium upland ridges and side slopes. The shrink-swell potential is low, erosion is moderate, and water capacity is moderate.
11C	Craven-Uchee complex, 6- to 10-percent slopes	This soil is deep, strongly sloping, and so intermingled that it is not possible to map them separately. They are found on side slopes and narrow ridge tops. The shrink-swell potential is low to moderate and the soils have a severe erosion hazard. Water capacity is low to moderate.
12	Dogue loam	This soil is deep and nearly level. It is found on narrow ridges and low-lying terraces. The shrink-swell potential is low to moderate. Erosion is slight, and water capacity is moderate.
14B	Emporia fine sandy loam, 2- to 6-percent slopes	This soil is deep and gently sloping and commonly found on medium and broad upland ridges. The shrink-swell potential is low, erosion is moderate, and water capacity is moderate.
14C	Emporia fine sandy loam, 6- to 10-percent slopes	This soil is deep and strongly sloping and is found on side slopes and narrow ridges. Shrink-swell potential is low, threat of erosion is severe, and water capacity is moderate.
15D	Emporia complex, 10- to 15-percent slopes	This soil complex is composed of deep, moderately steep soils that formed over layers of fossil shells. It is found on side slopes along rivers, creeks, and drainageways. The shrink-swell potential is low to moderate. Threat of erosion is severe, and available water capacity is moderate.
15E	Emporia complex, 15- to 25-percent slopes	This complex consists of areas of deep, steep Emporia soils and areas of similar soils that have formed over layers of fossil shells. It is found on side slopes along rivers, creeks, and drainageways.
15F	Emporia complex, 25- to 50-percent slopes	This complex is very similar to the previous one, except that it is steeper.
17	Johnston complex	This complex consists of areas of nearly level areas of Johnston soils and areas of similar soils that have formed over fossil shells. They are on flood plains and along major drainageways throughout York River State Park. The soil complex has low potential for shrink-swell. Erosion is a moderate threat and water capacity is high.

Table 3, continued
TASKINAS CREEK SOILS

Soil Unit	*Soil Type*	*Description*
18B	Kempsville fine sandy loam, 2- to 6-percent slopes	Deep, gently sloping soils found on side slopes and uplands. Shrink-swell potential is low, and erosion threat is moderate. Water capacity is moderate.
19B	Kempsville-Emporia fine sandy loam, 2- to 6-percent slopes	This complex is composed of deep, gently sloping soils on medium to broad upland ridges and side slopes. Shrink-swell potential is low, threat of erosion is moderate, and the available water capacity low.
20B	Kenansville loamy fine sand, 2- to 6-percent slopes	This soil is deep, gently sloping and found on upland ridges. Slopes are smooth, and the shrink-swell potential is low. Erosion by water is slight and by wind is moderate. Water capacity is low.
25B	Norfolk fine sandy loam, 2- to 6-percent slopes	This soil is deep and nearly level. It is found on medium upland ridges and has a low shrink-swell potential. The water capacity is moderate, as well as threat of erosion.
29A	Slagle fine sandy loam, 0- to 2-percent slopes	This soil is deep and nearly level. It is found on upland terraces, broad upland flats and in slight depressions. It has a low shrink-swell potential, a slight threat of erosion, and a moderate water capacity.
31B	Suffolk fine sandy loam, 2- to 6-percent slopes	This soil has a low to moderate shrink-swell potential, slight threat of erosion and moderate available water capacity. This type of soil is deep and gently sloping and is generally found on long narrow areas of broad uplands and on side slopes next to drainageways.
34B	Uchee loamy fine sand, 2- to 6-percent slopes	This soil is deep, gently sloping and found on upland ridges and side slopes. The shrink-swell potential is low to moderate. Erosion is slight by water and moderate by wind.

the soil is characterized by low bulk densities, high fiber content, and a high percentage of organics. The creekbank and levee regions show a pronounced decrease in water content due to increased riverine clay and silt deposition and decreased organic matter. The soils are described in Table 4.

BIOLOGY

Habitats and Vegetative Communities

GOODWIN ISLANDS The Goodwin Islands complex contains a representative assemblage of marsh-island habitats and associated biological communities (Figure 14 and Table 5).

Prominent beach and overwash fan habitat exists on the northern side of the main island. This habitat is experiencing moderate to severe erosion, as evidenced by exposed peat substrate, wave cut terraces and overwash fans. The sand substratum is sparsely to moderately vegetated by beach grasses and shrubs.

Extensive polyhaline marshes with both low and high marsh components characterize most of the Goodwin Islands complex. The tall form of saltmarsh cordgrass (*Spartina alterniflora*) dominates the low marsh flora and covers approximately 205 acres or 70 percent of the emergent marsh area (Silberhorn, 1981). Common reed grass (*Phragmites australis*) has invaded several areas in the marsh, replacing native big cordgrass (*S. cynosuroides*).

The high marsh contains a mosaic of the following plant associations: monospecific stands of short-form *S. alterniflora*; monospecific stands of saltmeadow hay (*S. patens*); salt pans vegetated by saltgrass (*Distichlis spicata*)

Figure 13
SWEET HALL MARSH SOILS MAP

Table 4
SWEET HALL MARSH SOILS

Soil Unit	*Soil Type*	*Description*
115A 115B	Bama soils	These soils are fine loamy that formed in loamy marine sediments on uplands in the Coastal Plain. Slope is dominantly 0 to 6 percent but ranges to 15 percent. The soils are well drained and runoff is slow to medium. The permeability is moderate. The depth of the water table is more than 6 ft..
11	Conetoe soils	These soils are loamy and are on stream terraces and low marine terraces of the Coastal Plain. Slopes range from 0 to 5 percent. These soils are well drained and the runoff is slow. The permeability is moderately rapid. The water table is deeper than 6 ft..
67A 67B 67C	Kempsville soils	These soils are fine loamy and were formed in loamy sediments on the upper Coastal Plain. Slopes are dominantly 0 to 6 percent but range to 25 percent. Kempsville soils are found on broad dissected uplands. They are well drained with a moderate permeability. The runoff is slow to very rapid. The depth of the water table is below 6 ft..
359A 359B 359C	State soils	These soils are fine loamy and were formed in loamy fluvial or marine deposits on low Appalachian and Piedmont Plateau stream terraces and on the Coastal Plain. Slopes dominantly range from 0 to 10 percent. The soils are well drained and runoff is slow to medium. The permeability is moderate. A seasonal high water table ranges from 4.0 to 6.0 ft. during the wet period of the year.
78A 78B	Tetotum soils	These soils are fine loamy and were formed in moderately fine textured fluvial stream terrace or lower Coastal Plain sediments. Slopes range from 0 to 50 percent. They are moderately well drained, and runoff is slow on nearly level areas and medium to very rapid on steeper areas. The permeability is moderate in the subsoil and moderate to rapid in the substratum. A seasonal high water table is between 1.5 and 2.5 ft. below the surface from December through April during most years.
145A	Tomotley soils	These soils are fine loamy and were formed in loamy marine or fluvial sediment. These soils are on nearly level flats and slight depression on terraces of the Coastal Plain. Slopes range from 0 to 2 percent. These soils are poorly drained and have a slow runoff. The permeability is moderate to moderately slow. In undrained areas, the water table is within 1 ft. of the surface during the seasonal wet periods.

and glasswort (*Salicornia virginica*); and monospecific stands of black needlerush (*Juncus roemerianus*). Marsh elder (*Iva frutescens*) is abundant at the marsh/shrub-scrub wetland ecotone. The forested wetland ridges on the main island are dominated by estuarine shrub-scrub wetlands (Cowardin et al., 1979) with a loblolly pine (*Pinus taeda*) overstory. These areas are designated by the National Wetlands Inventory as Palustrine Forested Wetland/Shrub-Scrub Saturated Wetlands. However, the wetland structure, species composition, and tidal influence suggest that the habitat is Estuarine Shrub-Scrub/Forested Wetlands instead. The dominant shrub is wax myrtle (*Myrica cerifera*). Subordinate species include black cherry (*Prunus serotina*), groundsel tree (*Baccharis halimifolia*), marsh elder, red bay (*Persea borboni*), loblolly pine, blackberry (*Rubus argutus*), and poison ivy (*Toxicodendron radicans*).

The upland ridge is vegetated by red oak (*Quercus rubra*), loblolly pine, cottonwood (*Populus deltoides*), and black gum (*Nyssa sylvatica*).

Figure 14
GOODWIN ISLANDS WETLANDS MAP
Poquoson West, Va. National Wetlands Inventory Map

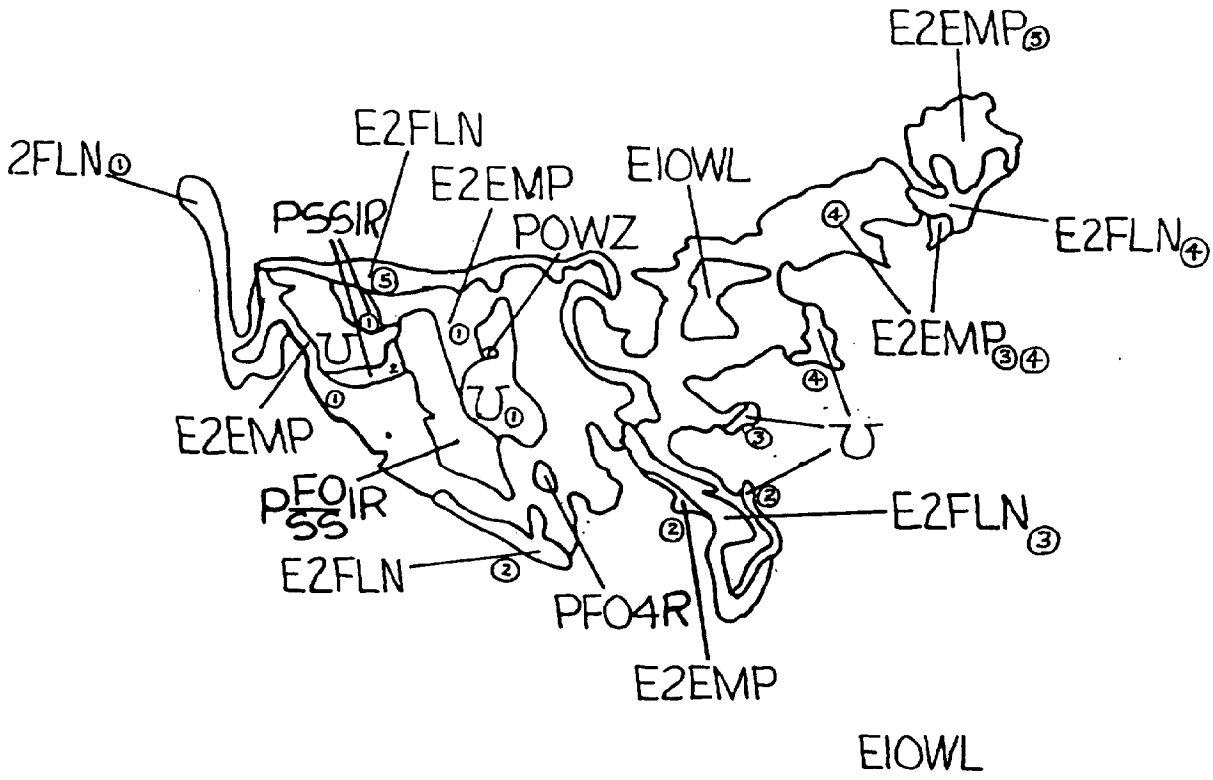


Table 5
GOODWIN ISLANDS WETLAND ACREAGE

NWI Code	*Wetland Type*	*Replicate*	*Area in Acres*
E2FLN	Estuarine, intertidal, flat, regularly flooded	1	23
		2	12
		3	19
		4	13
		5	21
		Total	**88**
E2EMP	Estuarine, intertidal, emergent wetland, regularly flooded	1	129
		2	7
		3	108
		4	6
		5	26
		Total	**6**
PSS1R	Palustrine, scrub-shrub wetland, broad-leaved deciduous, seasonally flooded-tidal	1	5
		2	6
		Total	**11**
U	Uplands	1	26
		2	3
		3	1
		4	8
		5	20
		Total	**58**
POWZ	Palustrine, open water/unknown bottom, intermittently exposed/permanently flooded	1	5
		Total	**5**
PFO4R	Palustrine, forested, needle-leaved, evergreen, seasonally flooded-tidal.	1	7
		Total	**7**
PFO/SSIR	Palustrine, forested/scrub-shrub, broad-leaved deciduous, seasonally flooded-tidal	1	29
		Total	**29**
E1OWL	Estuarine, subtidal, open water/unknown bottom	1	18
		Total	**18**
		Grand Total	**492**

Subaqueous bottoms offshore of the Goodwin Islands are covered by 300 acres of submerged aquatic vegetation dominated by *Zostera marina* (eelgrass) and *Ruppia maritima* (widgeon grass). These are the only seagrass beds on the south shore of the York River near its mouth (Orth et al., 1987), and they have increased in size in recent years as a result of recruitment of seedlings from upstream beds and by the rapid growth of the recruits (Orth et al., 1985).

Sand flats around the Goodwin Islands are regularly exposed at low tide and are extremely productive because of benthic algal mats and diatoms. They provide habitats for a variety of shellfish and other invertebrates, as well as nursery, spawning and foraging habitats for many fishes, birds and other animals.

On June 14, 1986, a lightning-induced wildfire broke out on the Goodwin Islands and burned between 80 and 115 acres of upland forest, shrub-scrub/forested wetland, and high marsh. The fire destroyed much of the above-ground shrub and herbaceous vegetation in burned areas, charred tree trunks, consumed organic soil layers, and exposed underlying peat layers. Studies to assess the impact of fire on the Goodwin Islands system

and its effect on plant recruitment and primary production are in progress (Silberhorn, in prep.).

CATLETT ISLANDS The Catlett Islands complex consists of nine prominent ridges ranging in size from 8 to 24 acres and 15 smaller ridges ranging in size from 2 to 6 acres. Broad low-lying swales occur between the ridges. A variety of coastal habitats are associated with the ridge-and-swale system: emergent wetlands, forested wetland hammocks, forested upland hammocks, tidal flats, and tidal creeks (see Figure 15 and Table 6).

Several types of emergent wetland habitat exist on the Catlett Islands: low marsh habitat inundated twice daily by semi-diurnal tidal action; high marsh habitat usually inundated less than twice daily; and shrub-scrub wetlands habitat irregularly or seasonally flooded. The wetlands communities associated with these habitats fall into the Brackish Water Mixed Community type according to the tidal wetland inventory for the Catlett Islands (Moore, 1976).

Saltmarsh cordgrass dominates the low marsh flora and occupies approximately 39 percent of the marsh area on the Catlett Islands. Saltmarsh cordgrass also grows in the swale habitat, along with saltmeadow hay, saltgrass, and black needlerush. These latter three species occupy 11, 19 and 20 percent, respectively, of the total marsh area and grow in monotypic stands or in heterogeneous groups. The high marsh is dominated by saltmeadow hay and saltgrass, and the shrub-scrub wetlands contain these same species along with marsh elder and groundsel tree. A variety of other salt-tolerant marsh plants is found in these marshes.

All but one of the ridges on the Catlett Islands are classified by the National Wetland Inventory as Broad-Leaved Deciduous Forested Wetland, seasonally flooded by tidal action (NWI, 1986). One ridge is classified as Coastal Upland Forest.

Several of the large ridges have been examined in a preliminary characterization of wetland and upland forest communities. Distinct habitat zones and associated vegetative communities are recognized on the larger ridges. In cross-section, the ridges are characterized by a marsh/shrub wetland ecotone; a shrub wetland/forested wetland ecotone; a ridge terrace; and an interior forested high ground. In long section, the size and shape of the habitats varies from ridge to ridge. The size of ridge (length and width), topography and elevation profile, exposure to open water (fetch), degree and duration of inundation, susceptibility to overwash, age of stand, and distance from parental source appear to affect the development of communities within these habitat zones. The generalized description of the habitat zones follows.

The **marsh/shrub wetland ecotone** is characterized by a fringe of marsh elder and groundsel tree. The transition zone from scrub-shrub wetlands to forested wetlands is characterized by a sparsely forested overstory dominated by young and/or stressed loblolly pine, red cedar (*Juniperus virginiana*), and, occasionally, American holly (*Ilex opaca*) and black cherry. The shrub layer in the transition zone contains wax myrtle, bayberry (*Myrica pennsylvanica*), saplings of the pine, cedar, holly and black cherry, and a variety of vines, including poison ivy, trumpet vine (*Campsis radicans*), blackberry, and Japanese honeysuckle (*Lonicera japonica*). Where human activity is evident, the shrubs and vines are thick. The groundcover of the transition zone is typically an extension of the high marsh and is dominated by saltmeadow hay and/or saltgrass with goldenrod (*Solidago sempervirens*), panic grass (*Panicum* spp.), giant foxtail (*Setaria magna*), and dog fennel (*Eupatorium capifolium*). On the seaward side of ridges exposed to open water with a northeast fetch, trees are frequently uprooted.

The **ridge terrace** is usually dominated in the overstory by larger, densely distributed loblolly pine. Red cedar, holly, black cherry, red maple (*Acer rubrum*), and persimmon (*Diospyros virginiana*) grow in the subcanopy and are more numerous and densely distributed than on the edge of the ridge. The understory consists principally of American holly, and the shrub layer is dominated by wax myrtle with dense to moderately dense

Figure 15
CATLETT ISLANDS WETLANDS MAP
Clay Bank, Va. National Wetlands Inventory Map

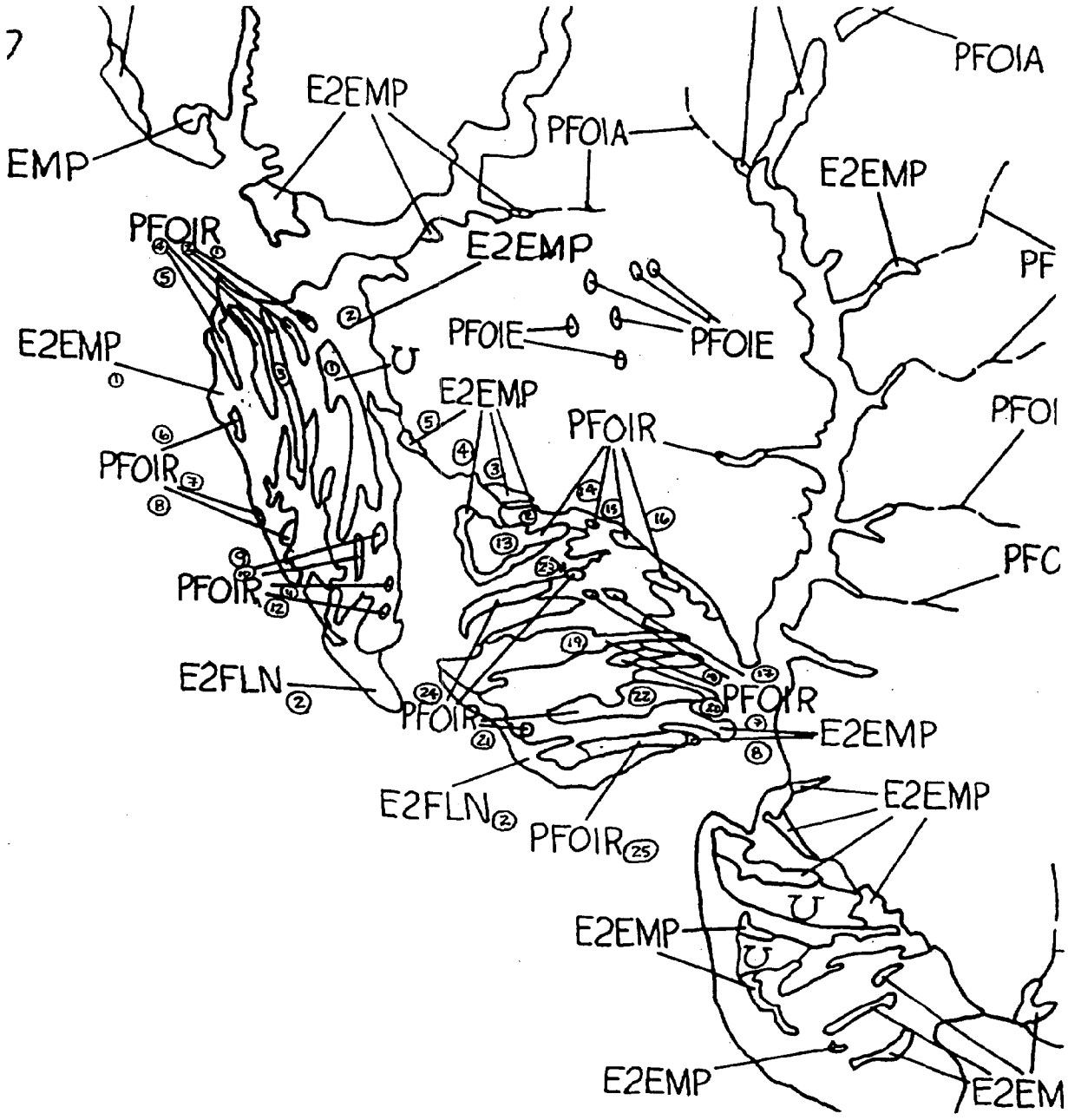


Table 6
CATLETT ISLANDS WETLAND ACREAGE

NWI Code	*Wetland Type*	*Replicate*	*Area in Acres*
Core Area			
E2FLN	Estuarine, intertidal, flat, regularly flooded	1	17
		2	20
			Total 37
E2EMP	Estuarine, intertidal, emergent wetland, irregularly flooded	1	145
		2	47
		3	6
		4	9
		5	1
			Total 208
PFO1R	Palustrine, forested, broad-leaved deciduous, seasonally flooded-tidal	1	9
		2	5
		3	19
		4	13
		5	9
		6	8
		7	5
		8	5
		9	4
		10	5
		11	6
		12	5
		13	19
		14	2
		15	6
		16	2
		17	3
		18	2
		19	24
		20	9
		21	8
		22	12
		23	2
		24	3
		25	4
			Total 189
U	Uplands	1	19
			Total 19
	Submerged bottoms	1	323
			Total 323
			Grand Total 776
Buffer Area			
U	Uplands on buffer	1	7
			Total 7
	Submerged bottoms	1	220
			Total 220
			Grand Total 227

thickets of poison ivy, trumpet vine, bull briar (*Smilax rotundifolia*), greenbriar (*S. bona-nox*), and Japanese honeysuckle. The ground is covered with pine needles, and herbaceous groundcover is sparse. Saltmeadow hay grows on the seaward side of the terrace and panic grass grows occasionally on the interior side.

The **interior high ground** of the forested wetlands contains more hardwood species than the ridge terrace, although species composition and dominance vary from ridge to ridge. Loblolly pine is always present but may be subordinate to hardwoods in places. Common hardwood species include white oak (*Quercus alba*), black oak (*Q. velutina*), southern red oak (*Q. falcata*), northern red oak (*Q. rubra*), laurel oak (*Q. laurifolia*), willow oak (*Q. phellos*), tulip poplar (*Liriodendron tulipifera*), sourwood (*Oxydendron arboreum*), black gum, sassafras (*Sassafras albidum*), sweetgum (*Liquidambar styraciflua*), Hercules club (*Aralia spinosa*), dogwood (*Cornus florida*), red maple, black cherry, persimmon, black locust (*Robinia pseudo-acacia*) and holly. The understory contains younger trees of the canopy species, and the shrub layer is sparse. The vines listed for the ridge terrace, as well as grape (*Vitis* spp.), morning glory (*Ipomoea purpurea*) and Virginia creeper (*Parthenocissus quinquefolia*), grow in the interior zone; however, the interior vine layer is not as thick as on the ridge terrace. The forest floor is covered with pine needles and a sparse herbaceous groundcover.

The one upland ridge on the Catlett Islands is forested with a mixed pine-hardwood forest. Habitat zonation and community composition are similar to those on the forested wetland ridges. The major difference is the abundance of hardwood species on the upland ridge. A variety of oaks is found in the canopy and understory, including southern red oak, northern red oak, white oak and black oak, although loblolly pine dominates in places. Hickories (*Carya* spp.), black gum, sassafras, sweetgum, and red maple are also part of the subcanopy and understory.

A timberland examination of forested wetland ridges owned by Dean A. Ablowich was prepared by the Virginia Division of Forestry in 1975. Jones (1975) reported the trees to be of variable age, mostly of two different age groups, 15 to 20 years for the younger pine and 40 to 50 for the older trees. Growth was fair. The report advised the owners to retain the timber stands for future volume growth with a minimum of human activity and to protect the timberland from forest fire.

The Catlett Islands once supported dense submerged aquatic seagrass beds. Eelgrass disappeared in the early 1970s and has not returned. A similar pattern has been observed elsewhere in the lower York River (e.g., around the Mumfort and Carmine Islands and at Clay Bank) (Orth et al., 1987). Attempts to re-establish these important grasses in historical areas has met with limited success. Survival rates of individual transplants planted in Fall 1984 to beds off Gloucester Point, Mumfort Island, and Clay Bank averaged 18.4 percent as of June 1985 (COE, 1987).

TASKINAS CREEK The shoreline along the transitional zone of the York River is characterized by fringing marshes along with pocket and tidal creek marshes extending landward into the uplands (Moore, 1980). The biological characteristics of Taskinas Creek typify those of the other creek systems in the transitional zone of the York River. Based on vegetative composition, total acreage, area flooded, ratio of shoreline length to marsh acreage, and lack of disturbance, Taskinas Creek is considered to be of primary ecological importance (Marcellus, Silberhorn and Dawes, 1973).

Several different vegetative communities exist within the Taskinas Creek watershed: six different emergent creek marsh communities; forested wetlands; mesic hardwood forests of upland ridges and ravines; and fringing marshes bordering the York River shoreline (Figure 16 and Table 7).

The low tidal creek marshes are dominated by the following wetland communities: saltmarsh cordgrass at the creek mouth and downstream stretches, threesquare (*Scirpus americanus* and *S. olneyi*) in the middle marsh

Figure 16
TASKINAS CREEK WETLANDS MAP
Gressitt, Va. National Wetlands Inventory Map

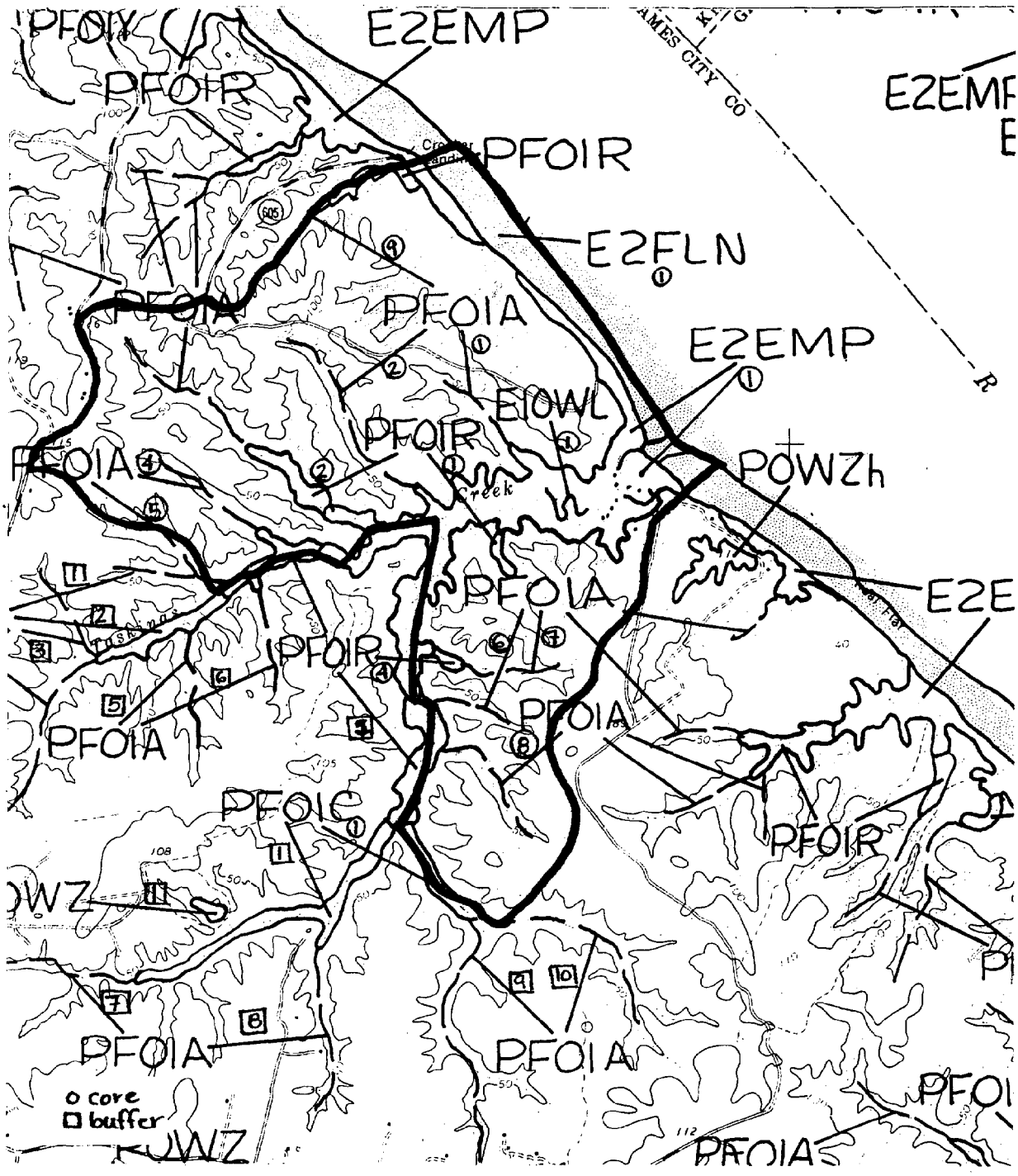


Table 7
TASKINAS CREEK WETLAND ACREAGE

NWI Code	*Wetland Type*	*Replicate*	*Area in Acres*
Core Area			
E2EMP	Estuarine, intertidal, emergent wetland, irregularly flooded	1	83
			Total 83
E1OWL	Estuarine, subtidal, open water/unknown bottom	1	1.3
PFO1R	Palustrine, forested, broad-leaved, deciduous, seasonally flooded-tidal	1	10
		2	12
		3	6
		4	8
		5	13
			Total 49
PFO1A	Palustrine, forested, broad-leaved deciduous, temporarily flooded	1	0.6
		2	2.6
		3	2.2
		4	1.7
		5	1.6
		6	1.1
		7	1.2
		8	1.7
		9	1.8
			Total 14.5
PFO1C	Palustrine, forested, broad-leaved deciduous, seasonally flooded	1	3
			Total 3
E2FLN	Estuarine, intertidal, flat, regularly flooded	1	38
			Total 38
U	Uplands	1	791
			Total 791
			Grand Total 980
Buffer Area			
PFO1A	Palustrine, forested, broad-leaved deciduous, temporarily flooded	1	1.1
		2	7
		3	1.5
		4	2.3
		5	1.6
		6	1.5
		7	2.4
		8	2.2
		9	2.2
		10	2.8
			Total 24.6
PFO1C	Palustrine, forested, broad-leaved deciduous, seasonally flooded	1	20
		2	3
			Total 23
PFO1R	Palustrine, forested, broad-leaved, deciduous, Seasonally flooded-tidal	1	9
			Total 9
POWZ	Palustrine, open water/unknown bottom, intermittently exposed/permanently flooded	1	7
			Total 7
U	Uplands.	1	350
			Total 350
			Grand Total 413.6

reaches, and freshwater mixed (where no single species covers more than 50 percent of the site) in the upstream stretches. The low marshes are regularly flooded at high tide. Slightly above the low marsh zone, the big cordgrass community exists and is flooded generally by those tides exceeding mean high water level. Saltmeadow hay and saltbush communities occupy the interior of the marsh, above mean high water elevation, and are only flooded by spring tides and storm tides. Big cordgrass, cattails (*Typha latifolia* and *T. angustifolia*), and saltmarsh bulrush (*Scirpus robustus*) border the uplands (Moore, 1980).

The saltmarsh cordgrass community occupies about 53 percent of the creek wetlands, while saltmeadow communities occupy 12 percent of the creek marsh area. The threesquare community covers about seven percent of the marsh and is significant both as a detritus producer and in food value to wildlife. The saltbush community covers nine percent of the marsh area, and the big cordgrass community occupies five percent (Marcellus, Silberhorn and Dawes, 1973).

The freshwater zone of Taskinas Creek provides the most diverse habitat in the entire creek marsh. This zone is flooded almost continuously and has a variety of plant species, including arrow arum (*Peltandra virginica*), pickerel weed (*Pontederia cordata*), wild rice (*Zizania aquatica*), narrowleaf cattail (*Typha angustifolia*), soft stem bulrush (*Scirpus validus*), and various species of pondweed. The distribution of plant species in freshwater areas is heterogeneous and changes seasonally as the different species grow and die. During the winter, the areas are barren mud hammocks with only scattered stalks of various species of plants visible (Marcellus, Silberhorn and Dawes, 1973).

Forested wetlands (or bottomland hardwood swamps) occupy five percent of the Taskinas Creek area within the park boundaries. These wetlands are characterized by a mixed hardwood community of red maple, black gum, green ash (*Fraxinus pennsylvanica*), and a variety of oaks and other water-tolerant tree species. The swamps are flooded by extremely high tides and generally receive most of their dampness from upland and groundwater discharges. There are active beaver ponds in the research core area. They differ in age and vegetative composition and represent successive phases of development.

Upland forests cover mesic ravine slopes and mesic ridges within the core area. This area is rugged and is typical of the terrain found in the transitional zone of the York River. The ravines have a canopy of American beech (*Fagus grandifolia*), tulip poplar, sweetgum, chestnut oak (*Quercus prinus*), and northern red oak and an understory of American holly and mountain laurel (*Kalmia latifolia*). These species are also found on the ridges above the ravines, along with sycamore (*Platanus occidentalis*), mockernut hickory (*Carya tomentosa*), Virginia pine (*Pinus virginiana*), loblolly pine, red maple, white oak, black oak, southern red oak (*Q. falcata* var. *falcata*), sassafras, and princess-tree (*Paulownia tomentosa*) (Perry, pers. comm.).

Fringing marshes are found along the York River shoreline at the mouth of Taskinas Creek. The dominant vegetation in these marshes is big cordgrass. Between the big cordgrass and the river, there is a narrow stand of saltmarsh cordgrass. One of the most significant values of this zone is erosion control. Although the shoreline does erode, it does so at a much slower rate than unvegetated shorelines. These fringing marshes also act as a filter to upland runoff and, thus, protect fish and shellfish spawning and nursery areas from sedimentation (Marcellus, Silberhorn and Dawes, 1973).

SWEET HALL MARSH The Sweet Hall Marsh Reserve consists of an extensive tidal freshwater marsh with adjacent bottomland hardwood forest and uplands in agricultural fields, a managed pine plantation, and mixed hardwood forests (Figure 17 and Table 8).

Sweet Hall Marsh is one of eight large wetland complexes between West Point and White House. It shows the best development of tidal freshwater marsh communities. Below Sweet Hall Marsh, the marshes are oligohaline, and above it, at Cousiac Marsh, there is an abrupt transition from freshwater

Figure 17
SWEET HALL MARSH WETLANDS MAP
New Kent, Va. National Wetlands Inventory Map

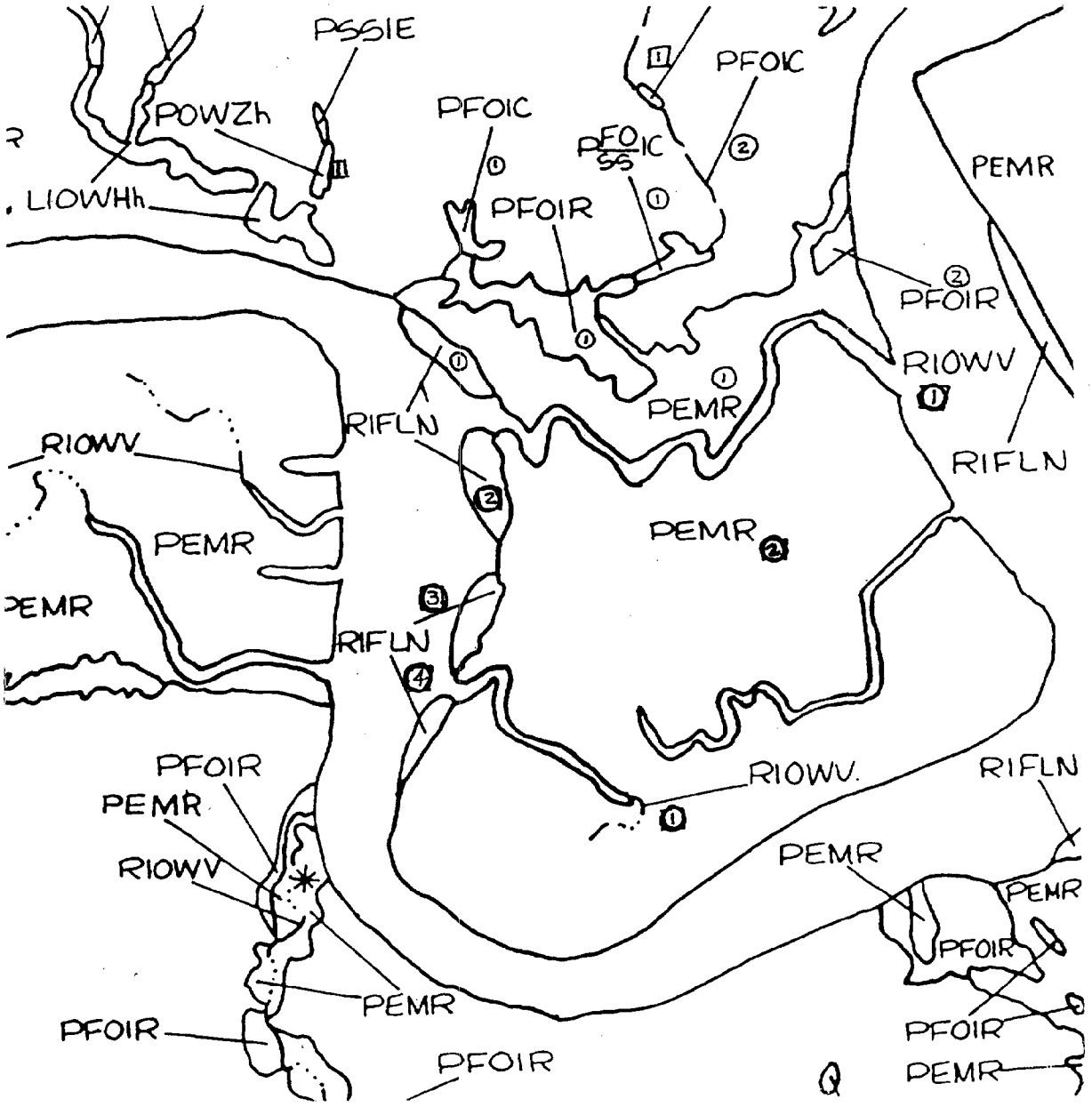


Table 8
SWEET HALL MARSH WETLAND ACREAGE

NWI Code	*Wetland Type*	*Replicate*		*Area in Acres*
Core Area				
PEMR	Palustrine, emergent wetland, seasonally flooded-tidal	1		918
			Total	**918**
PFO1R	Palustrine, forested, broad-vleaved deciduous, seasonally flooded-tidal	1		33
		2		2
			Total	**35**
RIFLN	Riverine, tidal, flat, regularly flooded	1		5
		2		10
		3		10
		4		7
			Total	**32**
RIOWV	Riverine, permanently flooded- tidal, open water/ unknown bottom	1		.8
			Total	**8**
PFO/SS1C	Palustrine, forested/scrub-shrub, broad-leaved deciduous seasonally flooded	1		9
			Total	**9**
PFO1C	Palustrine, forested, broad-leaved deciduous, seasonally flooded	1		8
		2		.9
			Total	**8.9**
U	Uplands	1		252
			Total	**252**
			Grand Total	**1,255.7**
Buffer Area				
PFO1A	Palustrine, forested, broad-leaved deciduous, temporarily flooded	1		4
		2		2.6
			Total	**6.6**
PSS1C	Palustrine, scrub-shrub, broad-leaved deciduous, seasonally flooded	1		3
			Total	**3**
POWZ	Palustrine, Open water/unknownbottom, permanently flooded/intermittently exposed	1		10
		2		1
			Total	**11**
U	Uplands	1		501
			Total	**501**
			Grand Total	**521.6**

to forested swamp. Above Cousiac Marsh, forested wetlands are the dominant wetland type, and marshes are only occasional features along the margins of swamps and uplands.

The marsh communities at Sweet Hall Marsh are classified as freshwater mixed communities (Silberhorn and Zacherle, 1987). These communities are highly productive and provide habitat and forage areas for a variety of wildlife and waterfowl, as well as fish spawning and nursery areas. The freshwater marsh communities are associated with the geomorphic zones described in the "Geology and Soils" section. The dominant species in the creekbank zone are arrow arum, smooth cordgrass, big cordgrass, smartweeds (*Polygonum* spp.), rice cutgrass (*Leersia oryzoides*), wild rice, water hemp (*Amaranthus cannabinus*), water dock (*Rumex verticillatus*), Walter's millet (*Echinochloa walteri*), and marsh milkweed

(*Asclepias incarnata*). The levee zone of the marsh is dominated by big cordgrass, arrow arum, Walter's millet, smartweed, sedges (*Carex* spp.), rice cutgrass, wild rice, water dock, reed grass, rushes (*Scirpus* spp.), cattail, marsh mallow (*Kosteletskya virginica*), water hemp, beggar ticks (*Bidens* spp.) and panic grass (*Panicum virgatum*). The low marsh interior is the most productive zone, with all of the previously named species, and is dominated by arrow arum. Also found here are square stem spikerush (*Eleocharis quadrangulata*), royal fern (*Osmunda regalis*), pickerelweed, marsh aster (*Aster vimineus*), waterhemlock (*Cicuta maculata*), and chufa (*Cyperus strigosus*). The sensitive jointvetch (*Aeschenomene virginica*), a candidate for federal listing as an endangered species, is found in Sweet Hall Marsh.

The tidal flats around Sweet Hall Marsh, although not vegetated by vascular plants, are extremely productive biological communities because of the microscopic algae and diatoms that grow on the surface of the sediment. The tidal flats provide habitat for a variety of shellfish, crabs, and other invertebrates, and they are also important spawning, nursery, or foraging habitats for many fish, birds and other animals.

The dominant canopy species in the bottomland hardwood forest of the research core area are green ash, black gum, red maple, and ironwood (*Carpinus caroliniana*). The area also contains sweetgum, sweetbay (*Magnolia virginiana*), tulip-tree, mountain laurel, red cedar, smooth alder (*Alnus serrulata*) baldcypress (*Taxodium distichum*), arrow wood (*Viburnum* spp.), greenbrier (*Smilax* spp.), wax myrtle, and flowering dogwood. Two types of herbaceous communities exist as groundcover. A herbaceous community similar to that found on the open marsh occupies very soft muck and is covered with water at high tide. A different herbaceous community dominates soft substrate on the solid tussocks of royal fern and roots of trees and shrubs. This community is dominated by royal fern, jewelweed, tearthumb, and cattail (Doumlele, 1976).

The uplands in the buffer area consist of an agricultural field and mixed hardwood-pine woodlot immediately adjacent to the marsh and a young loblolly pine plantation behind the bottomland hardwood swamp.

Fauna

GOODWIN ISLANDS The waters around the Goodwin Islands support both sport and commercial fisheries. Oyster reefs (*Crassostrea virginica*) and clam beds (*Mercenaria mercenaria*) are commercially harvested. The seagrass beds are scraped for molting blue crab (*Callinectes sapidus*). The dominant finfish species taken by trawl in this area of the lower York River include hogchoker (*Trinectes maculatus*), white perch (*Morone americana*), spot (*Leiostomus xanthurus*), oyster toadfish (*Opsanus tau*), striped bass (*Morone saxatilis*), weakfish (*Cynoscion regalis*), bay anchovy (*Anchoa mitchilli*), and Atlantic croaker (*Micropogonias undulatus*) (Van Engel, 1968; Bender, 1974; Jordan et al., 1972). Croaker, menhaden (*Brevoortia tyrannus*), spot, and weakfish comprised 95 percent of the commercial finfish landings between the Coleman Bridge and the York River mouth (including Back Creek and Thorofare areas) in 1986 (Virginia Marine Resources Commission, 1987). The six most important species caught by sportfishermen in the York River from the mouth to Pages Rock from 1955 to 1960 included croaker, spot, summer flounder (*Paralichthys dentatus*), striped bass, and puffer (Richards, 1962).

The York River and its tributaries serve as an important wintering area for migratory waterfowl, including Mallard (*Anas platyrhynchos*), Black Duck (*A. rubripes*), Canvasback (*Aythya valisineria*), Lesser Scaup (*A. affinis*), Canada Goose (*Branta canadensis*), Common Goldeneye (*Bucephala clangula*), Bufflehead (*B. albeola*), Ruddy Duck (*Oxyura jamaicensis*), and Tundra Swan (*Olor columbianus*) (Settle, pers. comm.).

A variety of resident shorebirds, songbirds and birds of prey are found on the Goodwin Islands, including Great Blue Heron (*Ardea herodias*), Herring Gull (*Larus argentatus*), egrets, Seaside Sparrow (*Ammospiza maritima*),

and Osprey (*Pandion haliaetus*). White-tail deer (*Odocoileus virginianus*) and raccoon (*Procyon lotor*) have been observed on the islands.

CATLETT ISLANDS The waters around the Catlett Islands support both sport and commercial fisheries. The dominant commercial landings from Clay Bank to the Coleman Bridge in 1987 were American shad (*Alosa sapidissima*) (101,969 pounds), Atlantic croaker (9,513 pounds), spot (3,567 pounds), weakfish (3,394 pounds), bluefish (*Pomatomus saltatrix*) (2,612 pounds), summer flounder (1,121 pounds), catfish (*Ictalurus* spp.) (256 pounds), mullet (*Mugil* spp.) (212 pounds), white perch (158 pounds), tautog (*Tautoga onitis*) (35 pounds), spotted weakfish (*Cynoscion nebulosus*) (18 pounds), and other fish (13,984 pounds). In 1987, 1,860,000 pounds of blue crabs were taken in this stretch of the lower York River (VMRC, 1988).

The Catlett Islands are an important wintering area for migratory waterfowl, including Mallard, Black Duck, Canvasback, Lesser Scaup, Canada Goose, Common Goldeneye, Bufflehead, Ruddy Duck and Tundra Swan. A variety of shorebirds, songbirds, and birds of prey are also found on the Catlett Islands, including Great Blue Heron, Herring Gull, egrets, Seaside Sparrow, Belted Kingfisher (*Megaceryle alcyon*), Red-Winged Blackbird (*Agelaius phoeniceus*), Carolina Chickadee (*Parus carolinensis*), Marsh Wren (*Cistothorus platensis*), Crow (*Corvus brachyrhynchos*), and Osprey. In the spring of 1988, there were at least four Osprey nests on the Catlett Islands.

Other animals include white-tailed deer, raccoon, muskrat (*Ondatra zibethicus*), Eastern box turtle (*Terrapene carolina*), ribbed mussel (*Volsella demissa*), fiddler crab (*Uca* spp.), and saltmarsh snails (*Melampus bidentatus*).

TASKINAS CREEK The brackish marshes of Taskinas Creek provide habitat for marsh species such as the brackish-water fiddler (*Uca minax*) and the marsh periwinkle (*Littorina irrorata*). The waters in and around Taskinas Creek support a variety of finfish dominated by spot, striped bass, oyster toadfish, weakfish, Atlantic croaker, and the sheepshead minnow (*Cyprinodon variegatus*).

The Taskinas Creek area supports a small population of muskrats. White-tail deer, opposum (*Didelphis virginiana*), raccoon, and gray squirrels (*Sciurus carolinensis*) are plentiful in the watershed.

The York River and its tributaries are an important wintering area for migratory waterfowl, including Mallard, Black Duck, Canvasback, Lesser Scaup, Canada Goose, Common Goldeneye, Bufflehead, Ruddy Duck and Tundra Swan (Settle, pers. comm.).

A variety of resident shorebirds, songbirds, and birds of prey are found in the Taskinas Creek watershed, including Great Blue Heron, Herring Gull, egrets, Seaside Sparrow and Osprey.

SWEET HALL MARSH Sweet Hall Marsh supports a variety of wildlife and waterfowl and more than 100 species of finfish. Muskrats inhabit the levee regions of the marsh and have burrows that crisscross the low marsh flat to the tidal creeks. Marsh rabbits (*Sylvilagus palustris*) are common inhabitants, and raccoon and white-tail deer visit the marsh at certain times to feed. Eastern mud turtles (*Kinosternum subrubrum*), banded water snakes (*Natrix sipedon*), and fiddler crabs are frequently encountered along the shoreline.

Hundreds of ducks consistently winter in Sweet Hall Marsh, where they feed on a variety of marsh plants and animal foods available in the shallow-water habitats. Among the more common winter residents are Canada Geese, Mallards, Black Ducks, Green-Winged Teal (*Anas crecca*), Ringnecks (*Aythya collaris*), Pintails (*Anas acuta*), and Wood Ducks (*Aix sponsa*). Great Blue Heron and other shorebirds, as well as Northern Harriers (*Circus cyaneus*), Belted Kingfishers, Marsh Wren and Red-Winged Blackbirds, are also common marsh inhabitants. Ospreys and Bald Eagles (*Haliaeetus leucocephalus*) also live along the Pamunkey River near Sweet Hall Marsh.

THE HUMAN ENVIRONMENT

GOODWIN ISLANDS

History and Socioeconomics

The Goodwin Islands are located near Yorktown, which played a major role in the development of the United States. Most importantly, Yorktown and surrounding areas were the locations of the culminating battles of the Revolutionary War and subsequent surrender of Lord Cornwallis and his British army. The area also played minor roles in the War of 1812 and the Civil War.

The development of York County was influenced in the early years by Yorktown because of its excellent port, and later by economic, employment, and associated development characteristics of federal military installations and nearby defense-oriented Newport News and Hampton. As Newport News and Hampton grew, the associated development (primarily residential) expanded outward into York County. York County's population remains highly dependent on these military and urban employment centers.

The Goodwin Islands are legally described as "Goodwin's Islands and Too's Marshes." The property was originally patented to John Chew in 1637 by John Harvey, Royal Governor of Virginia. The islands acquired their name when deeded by Chew's heirs to Major James Goodwin in 1660. The property remained in the Goodwin family as one parcel until 1877 when it was divided into six parcels and deeded to siblings of a niece of one of Major Goodwin's descendants. The islands were reunited into one parcel by the Norfolk Fisheries Corporation, which purchased individual parcels in 1911-1912. The islands, "together with the entire plant and equipment," were purchased by the Goodwin Island's Land Corporation in 1920. This implies that the islands were used as a fisheries plant. The islands changed owners several times until the mid-1960s when they were acquired by the Goodwin Islands Development Corporation, which, in 1968, proposed to develop the islands as a summer home resort area with 2,000 condominiums, a motel, golf course, convention center, 1,200-boat marina, and a bridge across the Thorofare. A group of local individuals, first calling themselves "Citizens to Save the Thorofare" and later incorporating as "York River Chapter of the Chesapeake Bay Foundation," fought the development of the islands for six years. After this proposal was defeated, the islands were acquired by the Environmental Preservation Company and, in 1984, again proposed for development (a marina, some commercial development and housing). Facing strong local opposition and a recommendation by the York County Planning Commission against the development, the owners withdrew the application and, also in 1984, donated the islands to the Endowment Association of the College of William and Mary in Virginia Inc. for use by the College and its School of Marine Science at Gloucester Point (i.e., VIMS). The islands remain uninhabited and are designated as a Resource Management/Protection Area in the 1983 York County Comprehensive Plan, primarily because of the presence of saltmarshes and forested wetlands, lack of access and utilities, severe flooding potential and extreme wetness.

Cultural Resources

An archaeological survey has not been conducted at the Goodwin Islands. In the event that one is conducted, it is likely that the Goodwin Islands will yield prehistoric and historic resources.

Present Uses

Owned by The Endowment Association of the College of William and Mary in Virginia Inc., the Goodwin Islands serve the education and research missions of the College and its schools. A discussion of current educational activities is presented in the Education Plan component of this management plan. The subaqueous bottoms below mean low tide mark are in the public domain and are protected and managed by the Virginia Marine Resources Commission. The subaqueous bottoms and waters support commercial and sport fisheries.

The Goodwin Islands are located offshore of Goodwin Neck and Crab Neck, moderately dense residential areas of York County (Census Area 505) whose population grew by 26.7 percent to 5,516 between 1960 and 1980 and whose number of housing units increased by 16.4 percent between 1970 and 1980. Population density (off military bases) for this census area was 1.09 persons per net acre in 1980. The majority of the neighboring Dandy and Seaford areas are designated Low-Density Single-Family Residential in recognition of the extremely wet conditions present over much of the area and the need to protect creeks from further siltation and water quality degradation. Most lots in subdivisions near the Goodwin Islands are one acre or larger.

Commercial land uses in the vicinity of Goodwin Islands include neighborhood convenience activities in the centers of older, well-established residential areas such as Yorktown and Seaford; general commercial activities along Route 17; tourist/commercial activities in the Yorktown area; and water-oriented commercial/industrial activities in the Seaford and Dandy areas. Water-related activities have historically held a very important position in York County's commercial base. They include marinas, seafood businesses and boat-building operations. The Goodwin Islands are thought to have been used for a barrel factory and a menhaden reduction plant.

Two major industrial plants, Amoco Oil Refinery and a Virginia Power generating plant, the York River Sewage Treatment Plant, and a county landfill are located on the Goodwin Neck peninsula. The availability of rail service, good highway access, public utilities, and large parcels of land combine to make this area well suited for heavy industrial development. The Goodwin Islands were once proposed for a deepwater offshore marine terminal. A Superfund National Priority List site, Chisman Creek, is in the vicinity.

Approximately half of York County's land area is owned by the federal government (military installations, or park property) or by adjacent jurisdictions (reservoir watersheds). Federal land holdings near the Goodwin Islands include the U.S. Coast Guard Reserve Training Center; Naval Fuel Depot; Colonial National Historical Park; Naval Weapons Station; Cheatham Annex; and Camp Peary.

Local Activities That Might Affect the Site

No activities exist or are planned that might have significant environmental impacts on the Goodwin Islands. However, the following events could harm the Goodwin Islands: oil spills, industrial accidents, dredging of the Thorofare, or a downriver bridge crossing of the York River.

CATLETT ISLANDS

History and Socioeconomics

In 1634, the Colony of Virginia was divided into eight shares. Among these was Charles River County, later changed to York County. In 1651, a portion of the county between the York and Piankatank rivers was separated from it and named Gloucester. In 1654, the western portion of Gloucester beyond the Poropotank River became part of New Kent County, and in 1790, the county was separated into Gloucester and Mathews counties. Early accounts describe Gloucester County as having a prosperous agricultural society, the main crop being tobacco. Gloucester was the scene of military encounters during the Revolution, the War of 1812 and the Civil War. The courthouse area, and the area immediately surrounding it, have served as a center of residential and commercial activity for more than 300 years.

The York River was not settled until 1630, primarily because of the unfriendly attitude of King Powhatan, whose capital was on the north bank of the river at Purtan Island (upriver from the Catlett Islands). Once civilization reached the York River, however, plantations developed and fine houses were built quickly on its shores.

The Catlett Islands were part of a 1639 King's Grant to George Menefie consisting of 3,000 acres along the north shore of the York River from Timberneck Creek to Aber-

deen Creek. Known originally as Timberneck Plantation and later as Rosewell, the grant included what became Timberneck Farm, Shelly Plantation and Rosewell Plantation. In 1680, the plantation then known as Rosewell was acquired by John Mann in a game of pushpin. Rosewell was inherited by John Mann's daughter Mary, who married Mathew Page, and later by son Mann Page, grandson Mann Page II, and great-grandson John Page. In 1793, John Page sold the estate's Timberneck Farm portion, including the marsh islands, to the first John W.C. Catlett. Descendants of the Catletts still own the property. The main house, the second built on the site, was built by the Catletts around 1800 and is on the National Register of Historic Places.

The Catlett Islands have remained in the Catlett family for almost 200 years, with the exception of two parcels. One parcel, containing 64 acres on the eastern end of the islands, was sold by the first John W.C. Catlett to Houlder Croswell in 1868. Croswell built a home on his island, locally called Croswell's Island. In 1921, Croswell's son sold the island to Francis LeGate, whose widow sold it in 1950 to William H. Ferguson Jr., the present owner. A second parcel, 79 acres on the western end of the islands, was sold by the first John W.C. Catlett's grandson Charles in 1920. This parcel passed through seven different owners before being purchased in 1972 by Dean A. and Merrilu Ablowich, the present owners. The Ablowich cottage was moved to the islands in the 1920s from a location across the York River.

Cultural Resources

An archaeological survey has not been conducted; however, in the event that one is conducted, it is likely that the Catlett Islands will yield prehistoric and historic resources.

Present Uses

Little direct human use of the Catlett Islands occurs today, except for waterfowl hunting, research, and commercial fishing in the waters around the islands. The islands are no longer inhabited. The Ablowich cottage was abandoned in 1985 as rising seas and vandalism took their tolls on it. The Ferguson hunting lodge has succumbed to a similar fate and is not salvageable. The one intact structure is a small hunting lodge built and used by Homer Buck, who leases hunting rights from John W.C. Catlett and William E. Catlett.

The Catletts' Timberneck Farm consists of approximately 1,000 acres of uplands and approximately 500 acres of wetlands (on the Catlett Islands). Approximately 500 acres of uplands are farmed, producing soybeans and corn, and with a small-scale livestock operation. Today, Gloucester County is the fastest growing county in the state. This increase reflects a general area-wide increase in population throughout the Middle Peninsula and the Newport News-Hampton area to the south. Although much of the northern half of the county remains rural and largely devoted to agriculture (chiefly soybeans and corn) or forestry, the southern portion, particularly the Route 17 corridor between Gloucester and Gloucester Point, has experienced rapid residential and commercial development in recent years. Scattered residential development of the shoreline in this area, including the shorelines of Timberneck and Cedarbush creeks, also has occurred at a rapid pace, contributing to problems associated with public water supplies and septic tank systems.

Local Activities That Might Affect the Site

The only existing or planned activities that might have significant environmental impacts on the Catlett Islands relate to increased residential development in adjacent watersheds. Possible impacts are increased runoff, sedimentation and nutrients from septic fields and fertilized lawns and gardens; displacement and poaching of wildlife; and introduction of exotic plant species. Another relates to a proposed upriver bridge crossing of the York River, which would encourage further residential development in the county.

TASKINAS CREEK

History and Socioeconomics

Before the seventh century, the Mattaponi and Pamunkey Indians (Algonquians) inhabited the Peninsula. The names of many land forms and creeks in the area are derived from Indian names. In York River State Park, Taskinas Creek, Mattaponi Trail, Pamunkey Trail and Powhatan Forks Trail are such names.

The first ownership record for Taskinas Creek is for Mount Folly, which was built in the 1600s and encompassed land at the western end of the park (Abbott Associates, 1975). In 1673, Mount Folly was owned by Brian Smith and consisted of 966 acres of high ground and 250 acres of marsh. Smith also owned 900 acres known as Taskinask. By 1689, Mount Folly and the 900 acres of Taskinask became the Daniel Parke estate (Virginia Archaeological Services Inc., 1988.) Nearby is Stonehouse, a 17th-century military retreat or outpost used during Bacon's Rebellion. It is on the National Register of Historic Places (Virginia Archaeological Services Inc., 1988).

A tobacco inspection warehouse stood at the mouth of Taskinas Creek during the 17th century. Colonial tobacco often was transported in poor condition, so an inspection system was set up to standardize the quality of the tobacco and improve its reputation (McCartney, 1990).

Riverview Plantation, located just outside of the park's eastern boundary, was a tobacco plantation in the 18th and 19th centuries. In the Civil War, the Union Army is said to have used Riverview Plantation as a hospital during the Battle of Richmond. The plantation house has been restored by the current owner on its original site (McCartney, 1990).

The Peninsula remained predominantly rural during the 18th century, and large plantations were interspersed with small and middle-sized farmsteads. During the 18th and 19th centuries, Mount Folly and Taskinask passed through several owners.

At the mouth of Taskinas Creek, a house and an artesian bottling plant were located at the mouth of Taskinas Creek in the 1930s. The main tract of land that now comprises the park was acquired by William J. Ferguson, who also owns a parcel of the Catlett Islands. Ferguson sold the 2,505 acres to the Commonwealth of Virginia in 1969 (Johnson, 1990).

Sycamore Landing, near the park, was originally public. When it became private, Ferguson donated one acre of his land for a new public boat ramp at Croaker Landing.

Cultural Resources

There are 15 archaeological sites within York River State Park. Two of the sites have been fairly thoroughly investigated and have been dated to between 1000 B.C. and 1500 A.D. Egloff, et al. (1988) concluded that two sites near Croaker Landing are locally unique. The sites indicate an unusually dense human occupation in an area that was otherwise culturally isolated. The cultural remains found are well preserved. Of significance is a previously undefined type of ceramic ware, *Croaker Landing*, and a previously undefined type of projectile point, *Potts Side-Notched*. The site was probably a small, perhaps transient, encampment that was occupied for short periods at various times of the year. It did not play a special role within the prehistoric settlement system and is rare for the Coastal Plain of Virginia.

Present Uses

The Taskinas Creek Reserve in York River State Park is used for day-use recreation and environmental education. A discussion of recreational and educational opportunities at Taskinas Creek is presented in the Education Plan component of this management plan.

Adjacent properties are in large landholdings, smaller single-family lots, and small convenience centers. Housing density in the Taskinas Creek watershed is low, but residential development is increasing. Between 1975 and 1980, a new trend in residential growth in James City County began to appear: the growth of small-lot subdivisions scattered in the traditionally rural upper part of the county.

Local Activities That Might Affect the Site

The only existing or planned local activities that might have significant environmental impacts on Taskinas Creek relate to increased residential development in the Taskinas Creek watershed and adjacent watersheds. Possible impacts include increased runoff, sedimentation, and nutrient loadings from septic fields and fertilized lawns and gardens; displacement of wildlife; and introduction of exotic plant species. Other scenarios relate to impacts associated with a possible upriver bridge crossing of the York River, a possible Ware Creek reservoir, and possible changes in salinity distributions in the York River resulting from withdrawal of water from the Pamunkey and Mattaponi rivers.

SWEET HALL MARSH

History and Socioeconomics

King William County was formed in 1702, 50 years after Capt. John West, a brother of Virginia's early governor, Lord Delaware, settled the lower county and named the peninsula West Point. Many homes built in the first quarter of the 18th century are still standing. The courthouse, built in 1725, is the oldest courthouse in continuous service in the United States.

Prior to Capt. John West, West Point was the seat of Opechancanough, chief of the Pamunkey, brother of Powhatan and leader of the massacre of 1622, which almost exterminated the English in Tidewater Virginia. At that time, the Pamunkey tribe was the largest in the Powhatan confederacy. Descendants of this tribe live today on the Pamunkey and Mattaponi Indian reservations on the banks of the Pamunkey and Mattaponi rivers, respectively.

Sweet Hall Marsh was part of the original Romancoke Estate on the Pamunkey River granted in 1653 to Col. William Claiborne, Secretary of State of Colonial Virginia. Comprising more than 5,000 acres, Romancoke extended from Herrick Creek (below Olsson's Pond) to Cohoke Creek and included the marshes now called Lee Marsh, Sweet Hall Marsh and Cohoke Swamp. The estate extended inland one mile. Claiborne divided the estate among three sons: Romancoke to William II; Sweet Hall to Thomas; and Cohoke to John. Romancoke remained in the Claiborne family until 1686. Since then it has had several owners, including George Washington, John Parke Custis, George Washington Parke Custis, and Robert E. Lee Jr. Romancoke is now owned by Sture Olsson, son of Ellis Olsson, who founded Chesapeake Corporation.

The Sweet Hall tract remained in the Claiborne family until 1756 when it was sold as two tracts: Sweet Hall, which included the Sweet Hall house built in 1720, and Tuckacomon or Tuckoman, which included Sweet Hall Marsh, then called Tocoman or Tuckoman Marsh. The Tuckoman Tract consisted of approximately 500 acres of uplands and 500 acres of marsh. The first Tuckoman house, built before 1801, stood on the high ground overlooking the Pamunkey River near where the Southern Railway runs through a cut today. A fire destroyed this house. The overseer's house, which still stands, became the second Tuckoman House. Tuckoman Estate changed hands several times during the late 19th century before the marsh was acquired by the Tacoma Hunting and Fishing Club in 1898. Since then, Sweet Hall Marsh has been passed down to descendants of the original club members.

Cultural Resources

Sweet Hall Marsh has not been surveyed for archaeological resources. Because of its long history of use, Sweet Hall Marsh and adjacent uplands probably would yield significant prehistoric and historic resources if surveyed.

Present Uses

Today, William and Fred Reed and Coleman Wortham III, grandsons of original members of Tacoma Hunting and Fishing Club, are the principal club members and owners of Sweet Hall Marsh. A record book in the clubhouse shows that Sweet Hall Marsh

has been used exclusively for hunting and fishing for almost 100 years. With the exception of John Dalton, every governor of Virginia until Gerald Baliles has hunted at Sweet Hall. Several presidents have been invited to hunt but were prevented from coming by the Secret Service, which felt that they could not be adequately protected while hunting. The uplands above Sweet Hall have always been used for timber and agriculture. The present clubhouse was built around 1947; prior to that, the clubhouse was where Wilton Dunn and family now live. The Dunns have been resident caretakers of Sweet Hall Marsh since 1898. The boathouse was built in 1982.

In addition to hunting and fishing, Sweet Hall Marsh is used for research and student projects by investigators from VIMS.

Tick Hill, the loblolly pine plantation above Sweet Hall Marsh, was acquired by Chesapeake Corporation in 1942. When purchased, the tract contained mixed loblolly and Virginia pine seedlings that had recruited to the site from seed trees left after a previous harvest. Chesapeake Corporation clear-cut Tick Hill in 1982-1983. The site was prepared for planting in the summer of 1983 and direct-planted by hand in the spring of 1984 using nine-month-old seedlings. The stand will be harvested at age 30.

Adjacent lands, like most of King William County, are primarily in agriculture or managed woodlands. The principal industry in King William is based on abundant forests. Lumber mills are scattered throughout the county and a major pulp and paper mill, owned by Chesapeake Corporation, is located in West Point. One-fourth of the county's population of 9,327 in 1980 lived in West Point. The remainder lived on grain and dairy farms or in low-density housing developments. The county's population grew by 24 percent between 1970 and 1980 and is still growing, primarily as a result of the growth in employment opportunities in the northern periphery of the Richmond metropolitan area.

Local Activities That Might Affect the Site

The most significant proposals that might harm Sweet Hall Marsh are those to withdraw water from the Pamunkey and Mattaponi rivers for urban needs. Several localities in and around the York River basin have identified the Pamunkey and Mattaponi rivers as being capable of meeting projected water needs into the next century. The consequences of the water withdrawal include long-term reduction in instream flow; change in the salinity distribution within the York River and its tributaries; and loss and alteration of wetlands, anadromous fish spawning areas, and migratory waterfowl wintering habitats. Higher salinities resulting from freshwater reduction could destroy all of the herbaceous freshwater vegetation in Sweet Hall Marsh and Cousiac Marsh and the woody vegetation of Cousiac Marsh, Cohoke Swamp and West Island.

Other impacts to Sweet Hall Marsh result from excessive boat wake in the thoroughfare and localized subsidence. Increased residential development along the Pamunkey River poses a threat to Sweet Hall through erosion and reduction in water quality.

ADMINISTRATION

ADMINISTRATIVE FRAMEWORK

The operation and management of the Chesapeake Bay National Estuarine Research Reserve System in Virginia is the responsibility of VIMS. However, this management plan is implemented through a cooperative effort between VIMS, participating state agencies, appointed advisory committees, affected landowners, and the Sanctuaries and Reserves Division of the National Oceanic and Atmospheric Administration. The following administrative framework identifies the roles and responsibilities of the agencies and advisory committees involved in implementing this plan. Landowners were also invited to serve on advisory committees and participate in decisionmaking. Agreements committing the

agencies and landowners to the long-term protection and management of the Reserve System are presented in the Appendix A.

Virginia Institute of Marine Science, The College of William and Mary

VIMS has been designated by the governor of Virginia to develop and manage the Reserve System and to receive and administer federal grants and state funds for it. General Assembly funds received by VIMS for the Reserve System can be used as state match for SRD awards to VIMS. VIMS also can use in-kind contributions and private sector funds as state match for SRD operations, research, monitoring and education awards to VIMS. Funds from other state and federal agencies, as well as from private donations, also will be used by VIMS to fund specific research and education projects at Reserve sites.

VIMS will serve as the headquarters for the Reserve system and take the lead role in implementing and coordinating programs for research, monitoring, resource protection and education at Reserve sites. The Reserve director and other staff are VIMS employees. VIMS will continue to provide research assistantships for graduate students in the School of Marine Science, internships for high school, undergraduate and graduate students, mentorships for teachers, and staff for the advisory committees affiliated with the Reserve System. The specific roles and responsibilities of Reserve program staff, research assistants and volunteers are listed below.

VIMS will be on-site manager for Reserve sites and will administer site-specific management agreements pertaining to on-site operations. The dean and director will be the signatory official for VIMS on such agreements.

The Board of Visitors, The College of William and Mary

The Board of Visitors of The College of William and Mary will hold title to Reserve System properties (e.g., Goodwin Islands) and will serve as grantor on donated conservation easements. As on-site manager of Reserve sites, VIMS will ensure the Board of Visitors that use of the sites is consistent with relevant policies and agreements. The Board of Visitors will approve proposals for property acquisition and facilities development and use of donated property value as state match for federal acquisition and development awards.

Endowment Association of the College of William and Mary in Virginia Inc.

The Endowment Association will hold gifts donated to the College for the Reserve System that are not transferred to the Board of Visitors or donated directly to VIMS. The Endowment Association will set up endowments for the Reserve System and distribute investment dividends to VIMS for use in approved research and education programs.

Virginia Council on the Environment

The Council on the Environment is the Commonwealth's federally designated recipient of funds under Sections 306 and 309 of the Coastal Zone Management Act. As such, the council solicits proposals from VIMS and other qualified applicants for projects that are appropriate for funding under these sections of the Act and administers awarded federal funds where appropriate. It is anticipated that some 306 and 309 projects will be conducted at the Reserve sites.

The Council on the Environment coordinates state activities under the Virginia Chesapeake Bay Initiative. VIMS reports to the council on research activities, including the development and management of the Reserve System. The council also coordinates state, regional and local government review of proposals pertaining to the development and management of the Reserve System. It will mediate any disputes arising from the implementation of interagency agreements between VIMS and other participating state agencies and between VIMS and NOAA.

Virginia Department of Conservation and Recreation

The Virginia Department of Conservation and Recreation owns York River State Park, which contains the Taskinas Creek Research

Reserve. The department's Division of State Parks manages the park. The division will retain this responsibility and assist in the cooperative management and operation of the Taskinas Creek Reserve site. The division will provide office space for the Reserve System's education coordinator as soon as appropriate space in the visitor center or proposed research and education center is available. Although the education coordinator will be supervised by the Reserve director, he or she will work closely with the park manager to ensure that Reserve activities are coordinated with park events and programs.

The division's additional responsibilities regarding the Taskinas Creek site are listed in the Memorandum of Understanding between the Department and VIMS (see Appendix A).

Other Relevant Agencies

Other relevant agencies will retain responsibilities for resource management and surveillance and enforcement of applicable statutes and regulations. These agencies will be represented on advisory committees. A description of applicable responsibilities and jurisdictions is contained in Appendix B.

Private Landowners

Owners of private property that is incorporated into the Chesapeake Bay National Estuarine Research Reserve System in Virginia will retain property rights and liabilities pursuant to the terms of conservation easements or management agreements. Landowners will be invited to participate on advisory committees and in volunteer programs. They will be kept informed of Reserve activities through meetings, correspondence and the Reserve newsletter. Copies of draft easements and agreements are presented in Appendix A.

Advisory Committees

The dean and director of VIMS will invite the heads of participating agencies to submit names of agency representatives for appointment to appropriate advisory committees. The dean and director also will invite representatives from research and academic institutions and the private sector to serve on the committees. The Reserve System director will provide the dean and director with a list of candidates on the basis of interest shown by individuals and areas of expertise. Appointments will be made for two years. Three advisory committees are being contemplated: resource protection; research and monitoring; and education. The composition, roles and responsibilities of these committees are described later in this plan.

Sanctuaries and Reserves Division, National Oceanic and Atmospheric Administration

The Sanctuaries and Reserves Division is authorized under Section 315 of the Coastal Zone Management Act to make matching (70:30) grants to states for acquisition, development, operations, monitoring and education at National Estuarine Research Reserves. Funding for research is available to any qualified individual or institution. As part of this authority, SRD is responsible for ensuring that each Reserve is managed according to National Estuarine Research Reserve System regulations (15 CFR 921) and individual management plans. To ensure effective Reserve management, SRD evaluates performance concerning the operation and management of the Reserve program, including the research, education and interpretation activities conducted there. When federal support for Reserve operations expires, SRD requires the managing state agency to submit an annual report on operations and management.

SRD publishes quarterly status reports describing ongoing activities at designated and proposed sites and periodically publishes guidance memoranda. SRD initiates an annual request for research, monitoring and education proposals, conducts a peer review, and awards matching grants. In addition, SRD is developing a coordinated information exchange program for Reserves to enhance nationwide understanding and management of estuaries.

STAFFING REQUIREMENTS, ROLES AND RESPONSIBILITIES

An adequate staff is essential for meeting the mission, goals and objectives of this management plan. When fully developed, the Research Reserve program should include the following salaried staff positions: program director; research coordinator; education coordinator; laboratory technician; and office manager/clerical. The Reserve System also will provide funding for research assistantships and internships and will hire part-time, seasonal and contractual employees as needed.

Unpaid volunteers will be a major component of the administrative framework.

Director

A director for the Reserve was hired by VIMS in 1987. The director, headquartered at VIMS in the Dean/Director's Office, is responsible for overall program development and management. Responsibilities are:

Prepares annual budget requests for state and federal funds, including justification for base funding and requests for new initiatives;

Oversees expenditure of state, federal and private funds, proportioning budgets to accommodate fiscal needs for salaries, assistantships, field work, equipment, audiovisual aids, supplies, travel and contractual services;

Approves programs and projects funded under the auspices of the Research Reserve program;

Prepares required semi-annual reports for the Council on the Environment, quarterly and annual reports for NOAA, and periodic reports for private funding sources;

Supervises the research coordinator, education coordinator and other staff as they are added, research assistants, interns, volunteers, and contractual personnel, or delegates supervisory role as appropriate;

Serves as principal contact for the Reserve System, represents VIMS in public relations and media contacts, and makes presentations to local officials, environmental organizations, and other interested groups;

Monitors day-to-day operation of the Reserve System and progress of sponsored programs and projects;

Directs program development, site selection, and nomination process for additional sites;

Directs baseline environmental assessment and socioeconomic background research for sites proposed for nomination;

Directs the development of management plans and environmental impact assessments for approved sites;

Coordinates the development of research, education and resource-protection priorities and presents findings to appropriate advisory committees for review and approval;

Coordinates activities with the Chesapeake Bay Program, Virginia Coastal Resources Management Program, Virginia River Basin Committees, Heritage Program, The Nature Conservancy, Chesapeake Bay Foundation, and other relevant groups;

Coordinates research program activities with those of the Chesapeake Bay Program and other Bay-wide programs;

Drafts conservation easements and management agreements for Reserve sites and negotiates terms and conditions;

Develops resource-protection guidelines and policies for the Reserve System as issues arise and presents them to the Resource-Protection Advisory Committee for appropriate action;

Provides guidance and mentorship to graduate students in marine resource management, undergraduate students in honors programs, high school students in the Governor's School for Science and Technology, and teachers-in-training;

Serves on the sub-faculty of the division of the School of Marine Science and develops and conducts special problems courses involving the Reserves; and

Assumes responsibility for other staff positions until these positions are filled.

Research Coordinator

The research coordinator will be headquartered at VIMS and is responsible for implementing and coordinating the research and monitoring component of this plan. Specific responsibilities are as follows:

Directs the research and monitoring program, designing and carrying out research and monitoring projects, where appropriate;

Provides staff support for the Research and Monitoring Advisory Committee and helps the director and participating agencies prepare and update an annual list of priorities for research and monitoring at Reserve sites;

Coordinates the review of priorities for research and monitoring by the Research and Monitoring Advisory Committee;

Issues requests for proposals for System-funded research and monitoring projects and initiates a peer review for proposals received. Assists SRD in the review of SRD-funded proposals when needed;

Evaluates the results of the peer review for Reserve-funded research and makes recommendations to the director and Research and Monitoring Advisory Committee;

Serves as liaison with the scientific community, promotes data utilization, and is the primary contact for scientists performing research within the Reserves;

Coordinates research activities within the System and communicates with other Reserve programs and other management areas, especially education and volunteer programs;

Administers Reserve-funded research grants, monitors research progress, evaluates progress toward achieving specified goals and objectives, and conducts a peer review of final reports. Assists SRD in reviewing SRD-funded projects when needed;

Prepares required reports for the Council on the Environment and NOAA;

Maintains a record of relevant research projects and products (e.g., reports, publications, databases);

Maintains an inventory of research equipment and supplies and identifies priorities for purchase;

Assists in the training of volunteers, research assistants and interns and monitors and evaluates their performance;

Recommends locations for research and monitoring stations within Reserve sites and provides technical advice and assistance to scientists in conducting research and monitoring as available;

Ensures that all necessary permits are acquired, liability release forms are signed, and proof of self-insurance is obtained (where necessary) before researchers initiate research or monitoring projects;

Develops additional research guidelines and policy statements as new issues arise and presents them to the Research and Monitoring Advisory Committee for appropriate action;

Reviews environmental impact proposals and provides written comments and expert testimony regarding Reserve resources, research findings, and environmental impacts of proposed activity;

Visits Reserve sites regularly and keeps field journal and photographic records of research activities;

Ensures that all research permit conditions are met, including removal of research apparatus and site restoration when projects are concluded;

Provides outreach to area schools, universities and research-funding agencies;

Makes presentations on Reserve-sponsored research to civic groups, professional societies and other groups; and

Reports to the director for the performance of these responsibilities.

Education Coordinator

The education coordinator will be headquartered at VIMS. He or she is responsible for implementing and coordinating the education program component of this management plan. Specific responsibilities are as follows:

Directs the education program, designing and carrying out educational and interpretive projects, where appropriate;

Provides staff support for the Education Advisory Committee and assists participating

agencies in preparing and updating an annual list of priorities for education, interpretation and visitor-use programs to be developed for the Reserve System;
Coordinates the review of priorities for education, interpretation, and visitor use with the Education Advisory Committee;
Issues requests for Reserve- and SRD-funded proposals for education, interpretation and visitor-use programs and projects and conducts a peer review for proposals received;
Evaluates the results of the peer review and makes recommendations to the director and Education Advisory Committee;
Is liaison with the academic community and acts as primary contact for educators bringing groups to the Research Reserve sites;
Coordinates approved education, interpretation and visitor-use activities within the Reserves and communicates with other Reserve management areas, especially research and volunteer programs;
In consultation with the Education Advisory Committee, reviews design proposals and construction progress for all interpretive facilities and exhibits to ensure that they are consistent with the goals of the Reserve, this management plan, and contractual arrangements;
Administers Reserve-funded education grants, monitors progress of funded education, interpretation and visitor-use activities, evaluates progress toward achieving specified goals and objectives, and conducts a peer review of education and interpretive products and media;
Provides technical advice and assistance, as available, for education and interpretation programs;
Trains and supervises volunteers who assist in education programs and monitors and evaluates their performance;
Prepares progress reports for the Council on the Environment and SRD;
Maintains a directory of all relevant education projects and products for the Research Reserve program;
Maintains an inventory of educational media, equipment and exhibits, and identifies priorities for purchase;
Develops additional educational guidelines and policy statements as issues arise and presents recommendations to Education Advisory Committee for appropriate action;
Visits Reserve sites regularly and keeps a photographic record of ongoing education, interpretation and visitor-use activities for use in slide presentations and exhibits;
Provides outreach to area schools, college, universities, and other environmental education organizations;
Makes presentations to civic groups, professional societies, and other groups upon request, as available; and
Reports to the director for the performance of these responsibilities.

Marine Scientist/ Laboratory Technician

The marine scientist/laboratory technician will be based at VIMS and will be responsible for helping in Reserve-sponsored research and monitoring activities. He or she will maintain computer software and hardware, databases, maps, photographs, library holdings, scientific field equipment, herbarium collection, drafting and publishing equipment and supplies, and other equipment used in analysis of sites. Specific responsibilities are:
Assists in field research, collecting and analyzing data, and preparing technical reports from biological, oceanographic and geographical data and information;
Planimeters and digitizes geographic data, develops habitat maps, and conducts integrated data analyses using geographical information systems and other appropriate software;
Conducts literature review and external database searches and synthesizes the findings;
Prepares computer tables, graphics and reports for publications and presentations;
Maintains numerical databases, scientific collections, field equipment, maps, photography, imagery and supporting technical reports;
Provides field support and assists program scientists and volunteers; and
Reports to the director for the performance of these responsibilities.

Administrative Assistant/ Office Manager

The administrative assistant will be headquartered at VIMS. He or she will provide support to the Reserve director by performing a variety of administrative functions, including reviewing, summarizing, prioritizing and expediting daily routine issues requiring top-level review and response. Specific responsibilities are as follows:

Designs and maintains a recordkeeping and milestone-tracking system for projects and awards. Apprises staff, volunteers, students, and contractors of upcoming due dates. Collects input from staff, volunteers, students and contractors and compiles quarterly performance reports for NOAA, semiannual reports for the Council on the Environment, and the annual VIMS report. Provides timely information to SRD for the National Estuarine Research Reserve System quarterly status report;

Maintains a calendar of work flow for staff, volunteers, students and contractors. Advises Reserve director on progress of assignments and recommends changes and additions;

Reviews mail for headquarters, assigns mail to appropriate staff for response and advises director of assignments. Reviews content and accuracy of completed information prepared for director's approval. Drafts responses to routine matters and interprets and responds to issues covered by established policies;

Schedules meetings of advisory committees. Works with director and coordinators to develop agendas. Prepares letters announcing meetings and handouts for meetings. Arranges meeting facilities and logistics;

Conducts research on special projects. For example, conducts deed research on properties proposed for inclusion in the Reserve System;

Serves as liaison with the Board of Visitors and Endowment Association of The College of William and Mary. Maintains Board and Endowment Association schedules, prepares resolutions and other pertinent documents, acquires minutes of meetings on Reserve matters, and prepares routine correspondence on Reserve and College matters;

Coordinates internship program. Prepares announcements of internship opportunities. Serves as interface between prospective interns and staff. Assists with paperwork, finding housing, and orientation;

Conducts various clerical jobs, including typing, word-processing, text editing, proofreading, mailing, filing and transcribing;

Prepares appropriate forms, inlcuding those for purchase orders, local travel, "vendacards," petty cash and vessel use;

Maintains inventory and stocks of office supplies, making purchases at VIMS Central Supply or through an appropriate commercial vendor when inventory gets low, and provides supplies to other staff;

Maintains mailing lists and prints labels when needed;

Makes travel arrangements for other program staff and helps visitors to the Reserve sites find appropriate accommodations;

Supervises printing and mailing of newsletter, brochures and reports and works with volunteers assigned to publication and writers' teams;

Serves as receptionist for visitors and people telephoning the office;

Assists other staff on special projects and publications; and

Reports to the director for the performance of these responsibilities.

ADVISORY COMMITTEE ROLES AND RESPONSIBILITIES

Resource-Protection Advisory Committee

The Resource-Protection Advisory Committee will comprise representatives of affected landowners, the Goodwin Islands Steering Committee, state resource management agencies, and affected counties. In addition, a staff member of the Council on the Environment and the Reserve director will serve as voting members. A NOAA representative will serve ex officio. The Resource-Protection Advisory Committee's duties are as follows:

Provides guidance for establishing annual priorities for resource-protection and restoration efforts within Reserve sites;

Reviews and monitors the progress of specific resource-protection activities carried out within a Reserve site to ensure that they are consistent with the goals and management policies of this plan;

Considers the need for additional resource protection as new issues arise and makes recommendations to regulatory agencies concerning the need for additions or revisions to existing regulations;

Monitors progress in implementing the acquisition strategy and provides guidance on the terms of conservation easements and management agreements; and

Reviews proposals for facilities development, including siting, design and construction, to ensure consistency with resource-protection policies and provisions of this management plan.

Research and Monitoring Advisory Committee

The Research and Monitoring Advisory Committee will consist of representatives of area colleges and universities, state resource management agencies (e.g., representatives of the original Research and Information Needs Committee), affected counties, Virginia Academy of Sciences, Virginia Sea Grant colleges, Virginia Consortium of Marine Science Graduate Programs, Chesapeake Research Consortium, and Chesapeake Bay Research Planning Committee. In addition, a staff member of the Council on the Environment and the Reserve director will serve as voting members. A representative of NOAA will serve as an ex officio member.

The Research and Monitoring Committee's responsibilities are as follows:

Reviews and approves priorities for Reserve research and monitoring projects;

Reviews Reserve research and monitoring proposals and interim and final research and monitoring reports;

Reviews permit applications;

Monitors and provides advice on local issues and new opportunities for cooperative research and monitoring;

Evaluates overall progress toward achieving research and monitoring priorities and adjusts long-term direction accordingly.

Education Advisory Committee

The Education Advisory Committee will comprise representatives of area institutions of higher education, state agencies conducting education, Alliance for the Chesapeake Bay, Chesapeake Bay Foundation, Mariners' Museum, Virginia Living Museum, and Virginia Marine Science Museum. In addition, a staff member of the Council on the Environment and the Reserve director will serve as voting members. A representative from NOAA will serve in an ex officio capacity. The Education Advisory Committee's responsibilities are as follows:

Reviews and approves lists of annual priorities for education and interpretation activities for appropriate Reserve sites;

Reviews education proposals and designs proposals for all educational and interpretive facilities, displays, media, curricula, training programs, etc., and monitors progress of specific activities to ensure that they are consistent with the goals of the Reserve program and this management plan;

Evaluates progress toward achieving priorities for education and interpretation and adjusting long-term priorities accordingly; and

In consultation with the Resource-Protection Advisory Committee, develops additional visitor-use policies as new issues arise, and provides recommendations to regulatory agencies for additions or revisions to existing regulations.

FIVE-YEAR PLAN OF ACTIVITIES AND STAFFING

Five-Year Activities Plan

The implementation of this management plan, including the hiring of staff; the initiation of research, monitoring, education and volunteer programs; and the development of

facilities, will begin after designation and will be phased in during the five-year life of the plan (see Table 9). Certain activities will take place before designation. After the first five-year period, this plan will be revised and the schedule changed accordingly.

Five-Year Staffing Plan

Table 10 presents a five-year staffing plan, which assumes the availability of funds and approval for hires. The start of Year 1 coincides with the beginning of the state fiscal year (July 1, 1991). Year 1 is also the second year in the FY1990-92 biennium. In Year 1, a full-time education coordinator and a part-time research coordinator will be hired using state funds, and a graduate intern will be recruited using private (endowment) funds. A marine scientist and an administrative assistant will be hired with federal funds. Requests will be made to the General Assembly for state funds and full-time equivalents for the federally funded positions, as appropriate. SRD funds will be used for those positions until state support is obtained.

PROGRAM GOALS, OBJECTIVES AND STRATEGIES

MISSION, GOALS AND OBJECTIVES

The mission of the Chesapeake Bay National Estuarine Research Reserve System in Virginia is to establish a statewide network of estuarine Research Reserves that will represent the diversity of coastal ecosystems found within the Virginia portion of the Chesapeake Bay and its tributaries, as identified for the Chesapeake Bay Program. Estuarine Research Reserves will be managed by the Virginia Institute of Marine Science in cooperation with relevant local, state and federal agencies and affected landowners.

Reserve sites will be managed to meet specific goals and objectives. The goals are long-term and somewhat open-ended, focusing on desired conditions rather than specific actions, whereas the objectives are short-term, measurable steps that can be taken to fulfill the goals. The activities and programs recommended for implementation under this plan are aimed at achieving the objectives.

Resource-Protection Goal

To protect the natural integrity of the ecosystems within the Research Reserve from disruptive activities inside and outside of the Reserve's boundaries

Resource-Protection Objectives

Through conservation easements, management agreements, memoranda of understanding, or land acquisition, to acquire and protect key land and water areas approximating entire ecological units and comprising the research core and adjacent buffer areas;

To coordinate existing surveillance and enforcement and, when necessary, establish a mechanism to increase resource protection;

To coordinate surveillance and enforcement and, when necessary, to establish a mechanism to increase resource protection;

To provide for adequate public participation as a means to promote compatible uses of the Reserve and enhance awareness of the need to protect sensitive resources; and

To rehabilitate Reserve habitats where necessary to restore natural biodiversity and prevent further resource degradation.

Research Goal

To use Research Reserves for long-term studies to improve understanding of natural and human processes in estuaries and to develop information for improved decisionmaking.

Research Objectives

To promote long-term baseline studies to characterize flora and fauna at Reserve sites and to elucidate ecological interrelationships;

Table 9
FIVE-YEAR ACTIVITIES PLAN

Predesignation: July 1, 1990–June 30, 1991

Finalize conservation easements and management agreements for Catlett Islands and Sweet Hall Marsh.

Finalize memorandum of understanding for Taskinas Creek.

Complete transfer of title for Goodwin Islands.

Prepare the final management plan.

Hire an education coordinator and research coordinator, contingent upon availability of funding.

Establish first volunteer teams by working with the Alliance for the Chesapeake Bay to place citizen water quality monitors at all York River Reserve sites and by continuing volunteer involvement in bird census and vegetation analysis at the Catlett Islands.

First Year: July 1, 1991–June 30, 1992

Manage designated sites according to the terms of conservation easements, management agreements and memorandum of understanding.

Receive an operations award from SRD.

Receive an acquisition and development award from SRD to develop concept and site plans for a research and education center and associated facilities, including state capital outlay proposal, required architectural, engineering, archaeological, historic preservation, and construction plans, and necessary permit applications.

Receive monitoring and education awards from SRD.

Encourage scientists to apply for funding under SRD research for priority research projects identified in this plan.

Seek funding for a study of software and hardware requirements for a geographic information system and database management system.

Establish and convene advisory committees.

Seek other sources of funding for research and education projects (e.g., from private contributions, Virginia Environmental Endowment, Earth Watch, Renew America, etc.).

Develop a manual for volunteer involvement in the Reserve.

Develop a Reserve brochure.

Develop a mobile exhibit.

Complete site identification and evaluation process for Research Reserve sites on the Rappahannock and Potomac rivers.

Prepare required reports for the General Assembly, Council on the Environment and SRD.

Second Year: July 1, 1992–June 30, 1993

Manage designated sites according to the terms of conservation easements, management agreements and memorandum of understanding.

Receive an operations award from SRD.

Negotiate conservation easements and management agreements for private and public lands adjacent to Reserve sites.

Receive an acquistion and development award to begin construction and/or renovation of a research and education center and associated facilities.

Evaluate achievements of first monitoring and education awards and apply for additional awards from SRD.

Encourage scientists to apply for funding under SRD research awards for priority research projects identified in this plan.

Recruit an unpaid volunteer coordinator.

Expand the volunteer program by working with the Chesapeake Bay Foundation to identify "Bay Watchers" for the Reserve sites and by expanding bird census, vegetation analysis and beach clean-ups to at least one additional York River Reserve site. Continue citizen water quality monitors at all York River Reserve sites, volunteer bird census and vegetation analysis at the Catlett Islands, and estuarine debris monitoring at the Goodwin Islands. Evaluate achievements and effectiveness of volunteer teams and team members and make changes, including adding teams and volunteers as needed to help support research and education programs funded under this phase.

Evaluate results of software and hardware analysis of GIS and database management requirements and purchase recommended software and hardware, as funds permit.

Continue to seek additional funds from public and private sources for research and education projects.

Convene advisory committee meetings in accordance with proscribed schedule;

Complete designation process for Research Reserve sites on Rappahannock and Potomac rivers; and

Prepare required reports for the General Assembly, Council on the Environment and SRD.

Table 9, continued
FIVE-YEAR ACTIVITIES PLAN

Third Year: July 1, 1993–June 30, 1994

Manage designated sites according to terms of operations award, conservation easements and management agreements.

Receive an operations award from SRD.

Evaluate achievements of second monitoring and education Awards and apply for third-year monitoring and education awards from SRD.

Continue to encourage scientists to apply for SRD research awards.

Develop an education and research prospectus for Reserve sites.

Coordinate, expand and evaluate volunteer programs.

Continue to maintain and update GIS and data files.

Continue to seek funds from public and private sources.

Continue to convene regular meetings of advisory committees.

Initiate site-selection process for Research Reserve sites on the James River and along the Western Shore of the Bay.

Prepare required reports for the General Assembly, Council on the Environment and SRD.

Fourth and Fifth Years: July 1, 1994–June 30, 1996

VIMS will continue to manage the Reserve sites, refining and modifying operations as experience is gained, and will continue to expand the program contingent upon the availability of funds and demonstrated interest in program expansion. During the fifth year, VIMS will convene an external body to review progress and achievements under this plan and to make recommendations for changes to the plan. VIMS will revise the management plan accordingly and will hire additional staff contingent upon the availability of funds and demonstrated needs.

To improve understanding of tributary water quality, particularly spatial and temporal dynamics, requirements for growth and survival of living resources, and contributions and effects of point and non-point pollution;

To promote better understanding of estuarine physical processes, such as tidal influence, circulation dynamics, freshwater inflow, stratification patterns and sediment dynamics;

To encourage studies that make effective use of past research and that address data gaps in the Reserve's information base; and

To provide for effective use and communication of research results.

Education Goal

To enhance public awareness, understanding and wise use of estuarine resources in the Chesapeake Bay and its tributaries.

Education Objectives

To promote knowledge of the Research Reserve, its resources and its programs, as well as knowledge of broader coastal issues and concerns related to estuarine management and protection;

To collaborate with other organizations to provide educational and interpretive services at appropriate Reserve sites;

To provide opportunities for teacher training, student projects, internships and assistantships in which participants work with scientists, gain field experience and learn about the importance of research results;

Through volunteer programs and personal contact with Reserve resources, to enhance interest in and commitment to the Chesapeake Bay and its tributaries;

To provide appropriate facilities that contribute to educational, interpretive, volunteer and research use of Reserve sites; and

To provide for appropriate traditional uses of Reserve sites, including hunting, fishing, trapping and boating.

Table 10

FIVE-YEAR STAFFING PLAN

Position (denotes new position)*	*FTE*
Year 1	
Program director	1
Education coordinator*	1
Research coordinator*	0.5
Administrative assistant*	1
Marine scientist*	1
Research assistant I	0.5
Research Intern*	0.5
Total Year 1 FTE	**5.5**
Year 2	
Program director	1
Education coordinator	1
Research coordinator	0.5
Administrative assistant	1
Marine scientist	1
Research assistant I	0.5
Intern	0.5
Clerical, part-time, hourly*	
Volunteer coordinator, unpaid*	
Total Year 2 FTE	**5.5**
Year 3	
Program director	1
Education coordinator	1
Research coordinator	0.5
Administrative assistant	1
Marine scientist	1
Research assistant I	0.5
Research assistant II*	0.5
Intern	0.5
Clerical, part-time, hourly	
Volunteer coordinator, (unpaid)	
Total Year 3 FTE	**6.0**
Year 4	
Program director	1
Education coordinator	1
Research coordinator	1
Administrative assistant	1
Marine scientist	1
Research assistant I	0.5
Research assistant II	0.5
Intern	0.5
Clerical, part-time, hourly	
Volunteer coordinator, part-time, hourly	
Total Year 4 FTE	**6.5**
Year 5	
Program director	1
Education coordinator	1
Research coordinator	1
Administrative assistant	1
Marine scientist	1
Research assistant I	0.5
Research assistant II	0.5
Intern	0.5
Office manager/clerical, part-time, hourly	
Volunteer coordinator, part-time, hourly	
Total Year 5 FTE	**6.5**

SITE BOUNDARIES AND ACQUISITION STRATEGY

GOODWIN ISLANDS The proposed Reserve consists of a 777-acre research core encompassing the entire Goodwin Islands complex, and an 830-acre buffer zone. The core area includes 276 acres of emergent polyhaline wetlands, 29 acres of broad-leafed forested wetlands, 7 acres of needle-leafed forested wetlands, 11 acres of scrub-shrub wetlands, 58 acres of upland forest, 88 acres of intertidal flats, 5 acres of palustrine open water (ponds), 303 acres of submerged aquatic vegetation beds, and 343 acres of non-vegetated subaqueous bottoms. Community type and biotic composition are typical of polyhaline conditions and insular biogeography.

The proposed buffer zone surrounds the Goodwin Islands and encompasses submerged aquatic vegetation beds, oyster reefs, unconsolidated substrates, and shallow open water. To the north, east and south of the Goodwin Islands, the buffer zone extends seaward from the core boundary to a depth of 2.0 m, which is roughly the boundary between wetlands and deepwater habitats, as defined by Cowardin et al. (1979). To the west, the buffer zone boundary coincides with the eastern channel of the Thorofare.

In 1984, the Goodwin Islands were donated to the Endowment Association of the Col-

lege of William and Mary in Virginia Inc., a charitable corporation established to receive gifts that serve the education and research mission of The College of William and Mary and its schools. The Endowment Association accepted the islands so that they could be used for scientific research and marine science education through the College's Virginia Institute of Marine Science and School of Marine Science. In 1990, the Endowment Association donated the property to the Board of Visitors of the College so that it could be incorporated into the Reserve as state property. That transfer enables VIMS to use the fair market value of the Goodwin Islands as state match for federal acquisition and development funds. The following restrictive covenants have been added to the deed:

> The Goodwin Islands are to be preserved as a natural area and protected from development in perpetuity;
>
> The College of William and Mary faculty, staff and students will continue to have access to the Goodwin Islands for research and educational use;
>
> VIMS will remain the on-site manager and responsible for controlling access to and activities on the Goodwin Islands; and
>
> Should [the Chesapeake Bay National Estuarine Research Reserve System in Virginia] cease to exist or should any of the requirements listed above be violated, the ownership of the Islands will revert back to the Board of Trustees of the Endowment Association.

Goodwin Islands Site Ownership

Owner	Parcel Size (in acres)
The College of William and Mary	492
Commonwealth of Virginia	1,115

CATLETT ISLANDS The proposed Research Reserve consists of a 690-acre research core, which encompasses all but a small portion (79 acres) of the entire Catlett Islands ecological unit, and a 220-acre buffer zone. The core area includes 168 acres of emergent mesohaline marsh, 164 acres of broadleaved forested wetlands, 14 acres of forested upland hammock, and 351 acres of submerged bottoms that once supported seagrass beds. The seaward boundary of the core area coincides with the seaward margin of the former seagrass beds at a depth of 0.6 m (2.0 feet below mean sea level). The landward boundary of the core area coincides with the wetland/upland boundary on Timberneck Farm. The buffer zone extends seaward to a depth of 2.0 m and includes 220 acres of submerged bottoms. The forested slope above the wetlands on Timberneck Farm forms a natural landward buffer to the core area.

The Catlett Islands are privately owned. The owners of all but one parcel have agreed to permit incorporation of the islands into the Reserve through conservation easement or management agreement and retain the right to:

> Continue to use the Catlett Islands for naturalistic purposes subject to the conditions set forth in the easement or agreement;
>
> Continue to hunt, fish, trap, and gather oysters on and around the Catlett Islands subject to applicable laws, or restrict the use thereof for these activities;
>
> Improve, repair, restore, alter, remove, remodel or replace existing permitted structures, provided that such activity is consistent with the management plan; and
>
> Continue to use the Catlett Islands, adjacent uplands, and waterways for all purposes consistent with the terms of the plan.

In return, VIMS agrees to:

> Prepare and keep current a management plan to direct future research activities involving the Catlett Islands;
>
> Manage the property for the purpose of conducting basic and applied scientific research consistent with the management plan;
>
> Conduct ecological surveys and maintain databases for monitoring purposes;
>
> Provide timely and accurate information through periodic meetings and reports to the landowners and the citizens of the Commonwealth regarding the quality and conservation of living and nonliving resources of the Catlett Islands; and
>
> Provide adequate liability insurance for those employed in permitted activities on the Catlett Islands and furnish evidence of such coverage.

The terms of the conservation easements and management agreement are presented

in Appendix A. The value of the donated conservation easements or property can be used by VIMS as match for federal acquisition and development funds.

Figure 18 shows property boundaries on the Catlett Islands. The easternmost parcel, Parcel 65 (64 acres) is owned by William H. Ferguson Jr., who has entered into a management agreement with VIMS. Five parcels are owned by Catletts. John W. C. Catlett Jr., Charles Catlett and Mary Armistead Catlett Burruss own Parcel 64 (115 acres), Parcel 90 (112 acres); and Parcels 87/89 (115 acres). Mary Armistead Catlett Burruss owns Parcel 91 (112 acres). These parcels have been donated through conservation easements to The College of William and Mary. The Commonwealth owns open-water areas below mean low tide.

Excluded from the Reserve is Parcel 88 (79 acres) owned by Dean A. and Merrilou Ablowich. After the closing of the comment period for the Draft Environmental Impact Statement and Draft Management Plan for the Reserve, Mr. and Mrs. Ablowich decided not to enter into a management agreement with VIMS under the terms set by the Commonwealth and NOAA. Therefore, this parcel will not become part of the Reserve.

Catlett Islands Site Ownership

Owner	Parcel Size	(in acres)*
William H. Ferguson Jr.	65	64
John W. C. Catlett Jr. et al.	64	115
John W. C. Catlett Jr. et al.	87/89	155
John W. C. Catlett Jr. et al.	90	112
Mary A. Catlett Burruss	91	112
Commonwealth of Virginia (open water)		352

* Note: The acreage figures from tax records do not agree with those from the National Wetland Inventory map because of different survey methods.

TASKINAS CREEK The Reserve site consists of a 525-acre research core within the boundaries of York River State Park. The core area will include: 83 acres of emergent brackish and freshwater wetlands, 65.7 acres of bottomland hardwood forest, 372 acres of upland deciduous forest, 3 acres of intertidal flats and 1.3 acres of creek bottom. A buffer zone will be developed if agreements can be reached with adjacent private landowners.

As a part of York River State Park, the Taskinas Creek component encompasses land and water already in the public domain. The area so defined is sufficient to meet the goals and objectives of the program, although additional buffer areas are desirable. The possibility of including privately owned wetlands, creek bottom and forests on ravine slopes adjacent to the park boundary as buffers is being explored. These areas will be proposed for inclusion at a later date if approved by the landowners and NOAA.

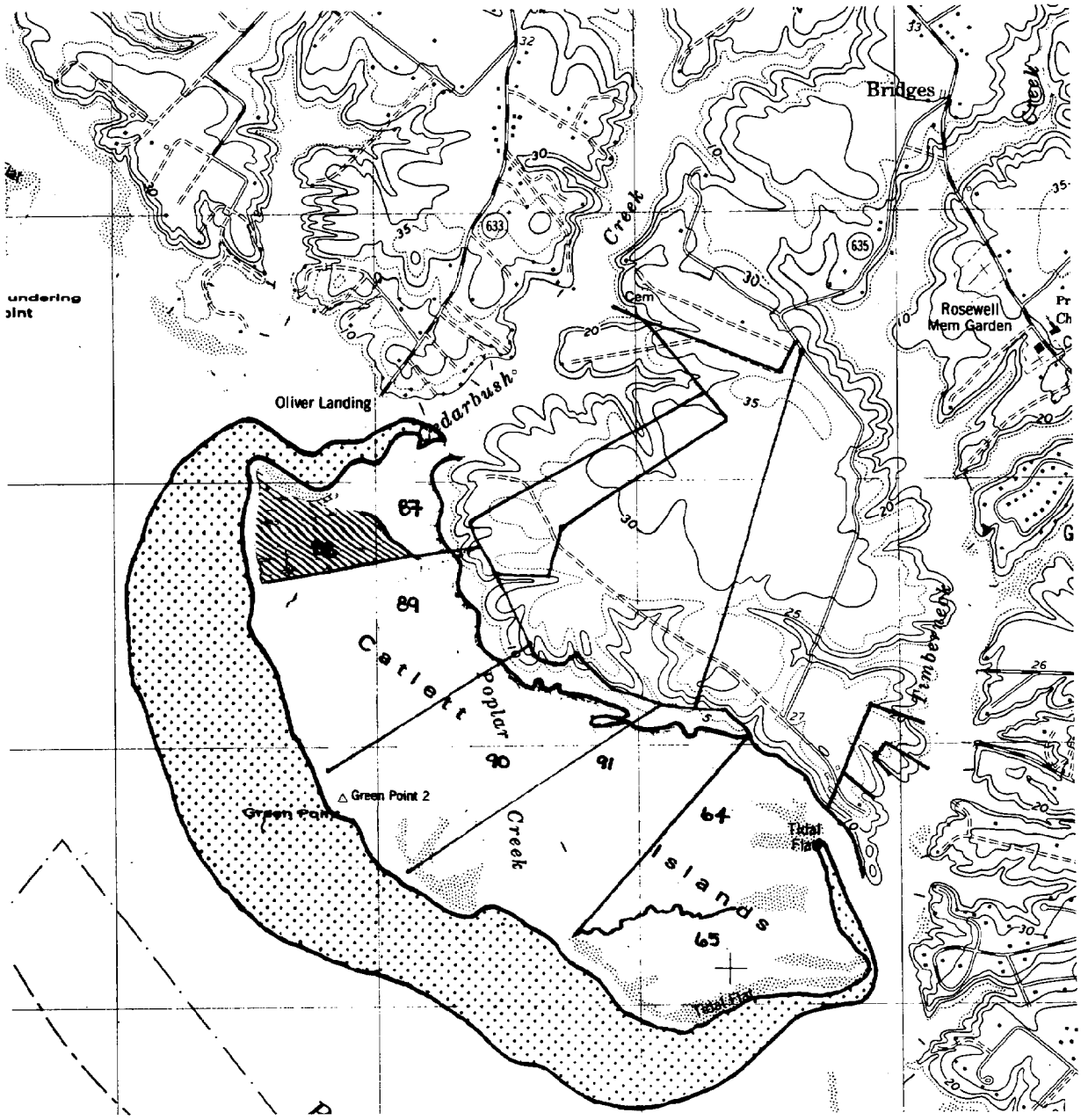
The Reserve's goals and objectives complement those of York River State Park. The Park is managed for passive recreational, educational and research uses. Because a partnership between the Virginia Department of Conservation and Recreation and VIMS would be mutually beneficial, a memorandum of understanding between these entities has been signed (see Appendix A) identifying roles and responsibilities for the department and VIMS regarding the Reserve program.

Taskinas Creek Site Ownership

Owner	Size (in acres)
Department of Conservation and Recreation	525

SWEET HALL MARSH The Sweet Hall Marsh research core consists of 871.26 acres. It encompasses 818 acres of emergent freshwater marsh, 35 acres of permanently flooded broad-leaved forested wetlands, 8.9 acres of seasonally flooded forested wetlands, 9 acres of scrub-shrub wetlands, and 0.36 acres of tidal flats. The proposed buffer zone consists of 521.6 acres. It encompasses 1 acre of permanently flooded riverine bottom, 10 acres of open water, 6.6 acres of temporarily flooded wetland forest, 3 acres of seasonally flooded scrub-shrub wetlands, and 501 acres of upland forest.

Figure 18
CATLETT ISLANDS PROPERTY BOUNDARIES



Except for that part of the Reserve that is below mean low water, which is owned by the Commonwealth, the core and buffer areas are privately owned. The marsh core and part of the upland buffer are owned by Tacoma Hunting and Fishing Club and the forested wetland core; the remaining upland buffer is owned by Chesapeake Corporation. (Figure 19). Chesapeake's upland property is managed for pulpwood production and is scheduled for harvest in 2004. There is a natural vegetative buffer strip between the pine plantation and the forested wetlands.

The Tacoma Hunting and Fishing Club and Chesapeake Corporation have signed management agreements with VIMS (see Appendix A). The landowners permit access to the property for research and education but reserve for themselves, their personal representatives, their heirs, their successors, and their assigns the right to:

Continue to use Sweet Hall Marsh for naturalistic purposes subject to the conditions set forth in the agreement;

Continue to hunt, fish, and trap at Sweet Hall Marsh subject to applicable laws, or lease or restrict the use thereof for these activities;

Create ponds in the buffer area above Sweet Hall Marsh and raise and release ducks and geese;

Improve, repair, restore, alter, remove, remodel or replace existing permitted structures, provided that such activity is consistent with the management plan; and

Continue to use Sweet Hall Marsh and adjacent uplands and waterways for all purposes consistent with the terms of the agreement.

In return, VIMS agrees to:

Prepare and keep current a management plan to direct future research activities involving Sweet Hall Marsh;

Manage the property for the purpose of conducting basic and applied scientific research consistent with the management plan;

Conduct ecological surveys and maintain a current information base for monitoring purposes;

Provide timely and accurate information through periodic meetings and reports to the landowners and the citizens of the Commonwealth regarding the quality and conservation of living and nonliving resources of Sweet Hall Marsh; and

Provide adequate liability insurance for those employed in permitted activities on Sweet Hall Marsh and furnish evidence of such coverage.

Sweet Hall Marsh Site Ownership

Owner	Parcel Size (in acres)*
Tacoma Hunting and Fishing Club 18	949
Tacoma Hunting and Fishing Club 17	145
Chesapeake Corporation 12	189
Commonwealth of Virginia (open water)	352

* Note: The acreage figures from tax records do not agree with acreage figures from the National Wetland Inventory map because of different survey methods.

RESOURCE-PROTECTION PLAN

Management Policies

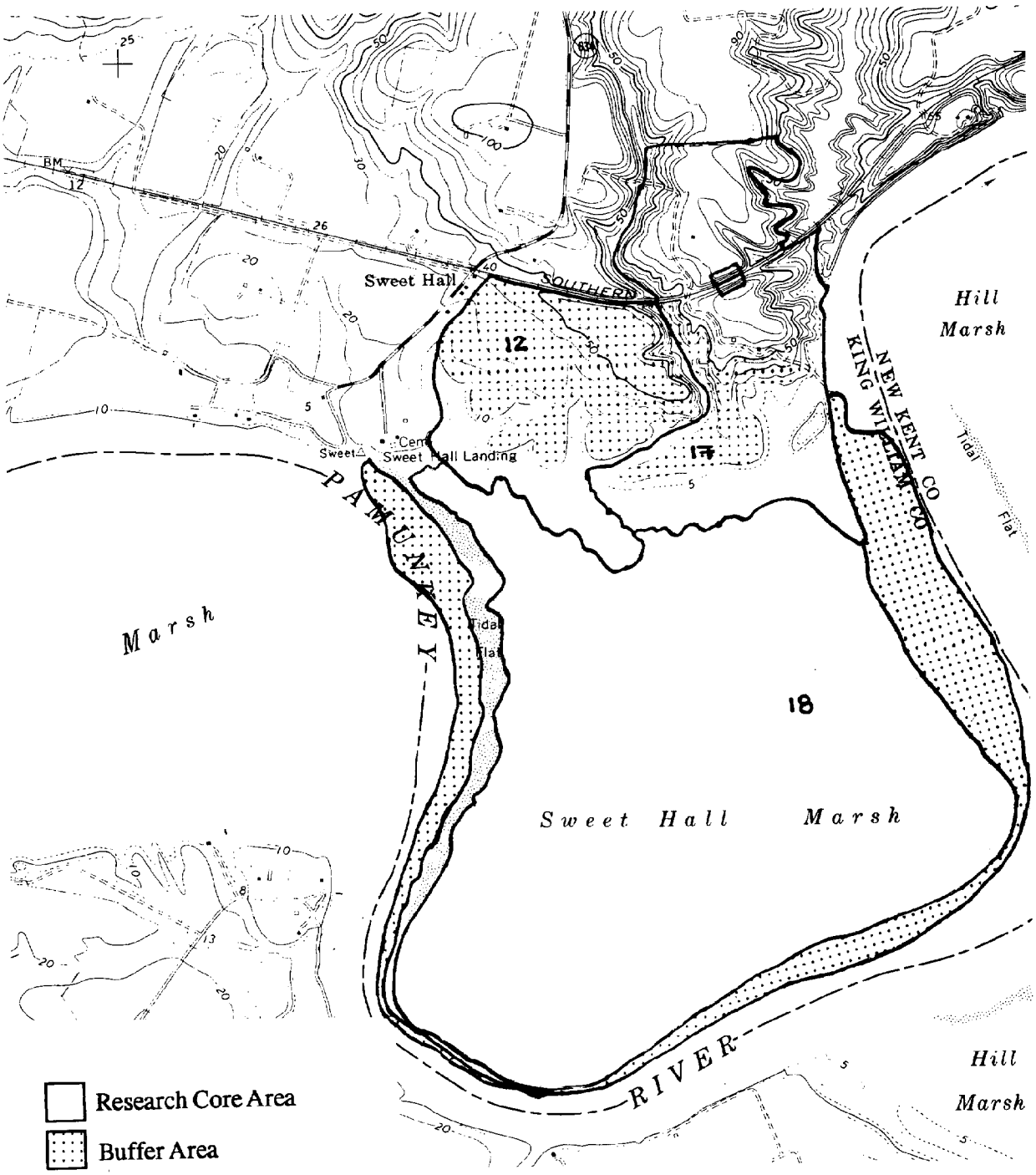
The following is a synopsis of the management policies that will be adhered to in fulfilling the goals and objectives listed above. Specific policies are given in Appendix B.

The health and natural integrity of Reserve sites will be protected and, where necessary, restored, to provide a productive, stable environment for research, education and compatible traditional activities. Reserve programs, activities and facilities will augment, not replace, the conservation, research, education and historical uses of the site by the site property owners. Reserve programs also will complement traditional uses outside Reserve boundaries. Public access policies will be developed individually for each site (see Public Access Plan below).

Unless otherwise stated in conservation easements, management agreements or memoranda of understanding, site property owners will continue to protect and administer their lands and facilities, including those designated as Reserves, and to use their lands and facilities for activities that do not adversely affect implementation of this management plan, conflict with Reserve goals and objectives, or adversely affect the Reserve's natural resources.

Present levels of traditional, compatible uses (e.g., hunting, fishing, trapping, oystering, boating) at and adjacent to Reserve sites

Figure 19
SWEET HALL MARSH PROPERTY BOUNDARIES



will continue as provided for by local, state or federal law. Activities of adjacent property owners will not be restricted by Reserve designation, although appropriate action will be considered if off-site activities threaten the Reserve's natural integrity or designated uses.

The Reserve manages sites cooperatively with VIMS, site owners, local government agencies, state government agencies and private organizations. Resource protection will rely on a number of existing federal, state and local laws and regulations, as well as Reserve management and site owner policies. Reserve staff will need to be knowledgeable of and involved with land and water use issues in the vicinities of Reserve sites.

VIMS will arrange to provide basic support services required to carry out this management plan. Federal and state funding may be used for capital improvements, such as the construction of Reserve facilities or improvement of access roads, boat ramps and trails. Funds from a variety of federal, state and private sources will be sought to fund research and education programs. Reserve budget and proposals will follow the state fiscal year, July 1 through June 30. VIMS will coordinate the distribution of federal, state and private funds and will act as liaison between NOAA and the site owners, agencies and organizations involved in Reserve programs.

Land will be brought into the Reserve program only through agreements with willing participants or through fee-simple acquisition from willing sellers. The Commonwealth will not use condemnation procedures to acquire land for the Reserve program.

Resource protection and non-manipulative research will be given the highest priorities in the management of Reserve sites. With the exceptions of samples taken for approved research programs and fish and game taken under site-specific traditional-use policies, nothing may be removed from the core area without the approval of the Reserve manager and site owner. Plants, animals, minerals or any parts of these (including such things as leaf litter) must remain to protect the core area's integrity. Removal of objects and samples from the buffer zone for approved research and education programs also requires prior approval. All projects will use best-management practices to preclude degradation of the natural environment and cultural resources. The use of toxic substances is prohibited in the core area and strongly discouraged in the buffer area. Proper disposal of all trash, litter and common pollutants is mandatory.

Restoration will be minimal. In general, Reserve sites are pristine, and any degradation is minor. Minor restoration may be undertaken to control erosion, eradicate exotic plants or re-establish native vegetation to preserve the Reserve site or enhance its research and education value. (Please see the Restoration Plan).

The planning of any construction will include the review of an archaeological survey of the area. A determination will be made as to whether or not known archaeological sites are directly significant and portions of the site would be disturbed by construction. Wherever feasible, construction plans will be altered to preclude disturbing sites having archaeological, historical or cultural significance.

The Reserve will retain the ability to alter or amend the specific management policies outlined in Appendix B as changes occur in the relevant statutes, laws and regulations; as resource-use patterns change; and as improved scientific information is obtained. The policies will be reviewed as part of the overall management review and modified as needed. The policies will be applied site-specifically as proscribed in relevant conservation easements, management agreements and memoranda of understanding.

State and Local Regulations Affecting Reserve Sites

VIMS will rely upon existing regulations, statutes and jurisdictions to protect the health and productivity of Reserve sites. In addition, VIMS and affected landowners will tailor and implement certain land-use policies for the specific needs of individual sites. Appendix B provides a brief description of state resource

protection responsibilities and regulations and a list of federal and state jurisdictions affecting the sites. Through the use of a Resource Protection Advisory Committee, VIMS will seek to coordinate the review of activities and proposals affecting the Reserve sites.

All local ordinances, county zoning restrictions, and critical area designations will continue to apply to Reserve sites. The following zoning classifications now apply:

GOODWIN ISLANDS The Goodwin Islands are zoned Residential-Conservation (RC). The Residential-Conservation District is the least intensive zoning classification in York County. It is intended primarily to apply to low-density residential use (5-acre minimum lot size) and to the vast amounts of federally owned military and U.S. Park Service property in the county, as well as to publicly or privately owned conservation or environmentally sensitive areas. Under this classification, primary permitted uses are conventional residential development (single-family detached dwellings), cluster residential development, and agriculture. The Goodwin Islands are uninhabited, and no utilities or services operate on the islands.

CATLETT ISLANDS The Catlett Islands are zoned as a Rural District (R-1). In general, that classification covers the rural areas in Gloucester County that are farms or forests. The intent of the district is to preserve the rural character of Gloucester County by maintaining farming and forestry, by conserving water and land resources, and by protecting watersheds. The district provides for very low-density residential housing but controls against random commercial and industrial uses and residential subdivisions. The permitted uses include agriculture, forestry, portable sawmills, single-family detached dwellings, mobile homes, home gardens, hunting clubs, fishing clubs, natural wildlife preserves and similar conservation areas, golf courses, country clubs, and riding stables.

The Catlett Islands are uninhabited, although several structures are present. One is a hunting lodge frequently occupied by Mr. Homer Buck, who leases hunting rights from the Catletts. Two other structures are no longer habitable. The Ferguson hunting lodge was destroyed by fire.

TASKINAS CREEK York River State Park has its own special land classification system as provided by the rules and regulations of the Division of the State Parks. Under that classification system the Taskinas Creek watershed is classified "undeveloped special," with small areas designated "undeveloped open." Undeveloped special areas are defined as areas not presently being considered for development or preservation that are highly susceptible to erosion, pose a safety hazard, or are being specifically managed (e.g., for wildlife or forests). This classification might restrict public use. "Undeveloped open" is not presently being considered for development and maintained in a natural condition, although not particularly unique, but representative of the local natural environment. These areas are available for public access.

Property outside the park boundaries is zoned as Agriculture, Forestry, and Rural Residential, Low Density Residential, or Conservation. Agriculture, Forestry, and Rural Residential areas include farms, forests and scattered homes for which utilities and urban services do not exist and are not planned for the near future. Appropriate activities primarily include continued farming and forestry, along with some recreational and public or semi-public and institutional uses, which may require a spacious site and are compatible with rural surroundings. Low Density Residential areas include residential development or land suitable for development with overall densities as great as four dwellings per acre. Conservation areas are not considered suitable for active development and usually consist of stream beds, wetlands, flood hazard areas and critical habitats.

SWEET HALL MARSH Sweet Hall Marsh and adjacent bottomlands and uplands are zoned as an Agricultural-Rural Residence District (AR). Usually, lands within AR districts are reserved for agriculture, forestry and ru-

ral land use, although low-density, single-family residences are allowed. The purpose of the AR district is to encourage continued agricultural and forest uses and preserve the natural beauty of rural areas of the county for which urban services, such as water and sewer mains, are not planned. Areas like Sweet Hall Marsh were designated natural features in the 1983 Comprehensive Plan for King William County and are recommended for protection from adverse impacts. These areas are being considered for designation as Forestal and Agricultural Districts in the revised comprehensive plan (in prep.).

Existing Permits and Licenses

Existing requirements for local, state and federal permits and licenses will be observed, and usual application procedures will be followed.

Reserve-Specific Permits

Two types of permits will be issued by VIMS for activities conducted within Research Reserve sites, a basic research permit to principal investigators conducting approved research projects and a special-use permit that may be issued under special circumstances for activities otherwise prohibited by management policies. Requests for basic and special-use permits will be carefully reviewed by Reserve staff and the Resource Protection Advisory Committee. In addition to Reserve permit applicants, the Division of State Parks will continue to issue permits for activities in York River State Park, and the Department of Game and Inland Fisheries will continue to issue scientific collection permits for any faunal resources under its jurisdiction.

Applications for permits from other agencies must be obtained from the appropriate agency. A permittee must carry approved Reserve permits at all times and properly display a Reserve flag from the research vessel or land vehicle to alert authorities and landowners that approved activities are in progress. The permit and flag must be returned to Reserve headquarters upon completion of the permitted activity.

Surveillance and Enforcement

Existing surveillance and enforcement mechanisms will remain in effect. Reserve sites fall under a number of different and sometimes overlapping jurisdictions of local and state agencies, and coordination and cooperation among all authorities is essential. The Division of State Parks will be responsible for surveillance and enforcement of park-specific rules and regulations within York River State Park. Law enforcement on private lands will remain the responsibility of county sheriffs and game wardens. VIMS will coordinate and cooperate with these regulatory authorities and invite their representation on the Reserve's Resource Protection Advisory Committee. VIMS will request to be notified of all warnings and citations occurring within Reserve boundaries.

In addition to regulatory authorities, the Reserve will use education, signs and other devices, as necessary, to deter vandalism, littering, poaching and other abuses. The Reserves will be adequately posted with information about access policies, controlled and allowable uses, reasons for restrictions, and consequences of violations. This information will be posted in strategic locations where problems have occurred or are occurring.

MANAGEMENT ISSUES

The following section describes significant issues related to the management of the York River components. The issues stem from conditions and potential conditions in the York River basin and at the individual sites. Identifying management issues allows pinpointing of research, education and resource protection needs and justification of programs and activities proposed in the Final Management Plan.

ENVIRONMENTAL CONDITIONS WITHIN THE YORK RIVER BASIN

The need to maintain the productivity and diversity of coastal habitats within the York River basin in the face of accelerated population growth and coastal development

The York River is one of the least disturbed of Virginia's tributaries, yet its watershed is one of the fastest developing. The river is relatively unpolluted and extremely productive, but there are signs of worsening ecological conditions within the basin, including declines in harvestable finfish, shellfish, and waterfowl; loss of submerged aquatic vegetation, wetlands, and deciduous forests; and increases in nutrients, turbidity, toxic substances, and other contaminants at selected locations.

Population growth is one of the major threats to environmental quality in the York River basin. Population growth east of Interstates 64 and 95 along the crescent from Fredericksburg to Hampton Roads is changing the rural character of the basin through a boom in housing and commercial development and concomitant development of water supplies, waste treatment facilities, roads, power facilities, landfills and municipal centers. The population in the York River basin is expected to increase by 57 percent to 280,000 by 2000 (COE, 1987).

The Reserve sites will play an important role in assessing the environmental impacts of population growth and land development in the York River basin. The sites will be used for monitoring environmental conditions; studying the roles of natural habitats in maintaining environmental quality; determining ecological carrying capacities of coastal habitats; and establishing scientific criteria for identifying and delineating critical areas.

The need to maintain freshwater flow regimes necessary to sustain estuarine habitats within the York River basin

Protecting minimum instream river flow is emerging as a significant management issue in Tidewater Virginia and elsewhere in the eastern United States where population growth and economic development have increased the need for increased offstream withdrawals. Several localities in and around the York River basin are studying potential water supplies that can meet projected needs in the next century.

Singularly and in combination, several of those studies could result in projects that would threaten the environmental integrity and stability of the Reserve sites. Hanover County is studying the feasibility of constructing Crump Creek Reservoir on the Pamunkey River to store water withdrawn from the Pamunkey at a rate of 25 million gallons per day (mgd). Spotsylvania County is studying the feasibility of impounding the Po River, a tributary to the Mattaponi River, which would reduce minimum instream flow by 8 mgd. A regional Raw Water Study Group, consisting of the cities of Newport News and Williamsburg and York and James City counties, has identified several scenarios involving the York River basin among the possible alternatives for its water supply needs. The scenarios are (1) construction of Ware Creek Reservoir to satisfy near-term needs of an estimated 4.5 mgd for the localities comprising the study group and long-term needs of 2.5 mgd for New Kent County; (2) construction of Ware Creek Reservoir to receive an additional 40 mgd from the Pamunkey River and 40 mgd from the Chickahominy River to satisfy long-term needs of an additional 35 mgd for members of the study group; or (3) construction of Cohoke Creek Reservoir on the Pamunkey River to store 75 mgd pump-over from the Mattaponi River to satisfy long-term needs of an additional 35 mgd for members of the study group and 3 mgd for King William County (Malcom Pirnie Inc., 1990).

Consequences of water withdrawals from the York River basin may affect Reserve sites through changes in salinity regimes and the loss and alteration of wetland habitats that provide substantial and critical ecological support to fisheries, waterfowl and wildlife. A 1983 run of the VIMS Salinity Intrusion Model for the Corps of Engineers' Water Sup-

ply Study for Hampton Roads, Va., predicted that a withdrawal rate of 40 mgd from the Pamunkey River would cause the 2 ppt and 6 ppt isohalines to move upriver 2.2 miles and 1.2 miles, respectively, from their locations during the driest month of a medium-flow year. This withdrawal rate probably would destroy 250 acres of freshwater marsh in Sweet Hall Marsh, 667 acres of freshwater marsh and 200 acres of forested wetlands in Cousiac Marsh, and 270 acres of forested wetlands in Cohoke Swamp (FWS, 1989a). Larger withdrawals would logically result in an even greater degree of salinity intrusion and concomitant impacts.

Other possible adverse environmental impacts associated with the water supply proposals are (1) alterations of the physical and chemical hydrology of the estuary, including water discharge volume and timing and water quality; (2) decrease in nutrient availability to downriver systems; (3) substantial elimination or modification of wildlife habitat, resulting in less diverse and less numerous fish, amphibian, reptile, mammal and bird populations; and (4) alterations of and barriers to the natural passive movement and migration of fish and other aquatic wildlife (EPA, 1989b). Reduced freshwater inflow also may alter the location of the turbidity maximum zone, change sediment delivery rates, and significantly alter basin geomorphology, which, in turn, could increase downstream erosion rates.

There are indications of salinity intrusion into the lower Pamunkey and Mattaponi rivers resulting from sea level rise and localized subsidence. At least one of the Reserve sites, Sweet Hall Marsh, is already threatened by sea level rise and land subsidence, which would be worsened by reduced freshwater riverine inflow.

Designation of Reserve sites emphasizes the national, state and local significance of these natural areas and the need to protect them from human influences that could change their natural conditions or the processes governing those conditions. Research at Reserve sites will be used to predict the impacts associated with freshwater withdrawal, sea level rise and local subsidence.

ENVIRONMENTAL CONDITIONS WITHIN SITE BOUNDARIES

Educational and recreational uses of Research Reserve sites are allowed to the degree that they do not disturb natural conditions or ongoing scientific investigations. Recent studies have documented the impacts of human activities, including hiking and camping, in protected areas (Cole and Marion, 1988). In general, the impacts include increased erosion, soil compaction, vegetation and wildlife disturbance or destruction, and introduction of non-native species. Such studies have found that considerable impact can occur rapidly and with only light use, whereas recovery requires long periods with no use. Protected areas also are impacted by people who deface signs, steal archaeological artifacts, poach wildlife, and litter. The environmental, social and economic costs of such abuses can be significant and irreparable. Lack of awareness is an underlying reason for neglect and willful abuses (Council on Environmental Quality, 1988).

Resource protection policies for Reserve sites will help maintain natural, healthy habitats for long-term study. The initial thrust of the long-term research and monitoring program will be to describe baseline conditions and functional relationships at Reserve sites. The program then will strive to develop reliable indicators of habitat health and monitor their status and trend conditions. Studies will be conducted to identify thresholds above which impacts are substantially increased and recovery times are extended and to develop a monitoring program to detect unacceptable impacts. The Reserve program will use corrective strategies to minimize impacts when threshold levels are exceeded and will undertake an education campaign to reduce impacts through increased public awareness and involvement in the Reserve program. Reserve management will prohibit public access to environmentally sensitive natural areas having low resistance to impacts and low resil-

ience to recovery and to areas containing artifacts of archaeological, cultural or historical importance. Facilities development plans will receive adequate environmental impact assessment. Reserve management will work with appropriate state and local agencies to ensure that activities occurring outside of Reserve site boundaries do not impact Reserve resources or programs. Advisory committees will be formed to ensure that monitoring and enforcement activities are coordinated.

PROGRAM DEVELOPMENT AND ADMINISTRATION

The need to develop independent but complementary Reserve programs in Maryland and Virginia recognizing the Chesapeake Bay as one natural system

In 1986, the governors of Virginia and Maryland agreed that the two states would coordinate efforts to establish Research Reserves within the Chesapeake Bay. Since then, Virginia and Maryland have continued this spirit of cooperation in developing and implementing site evaluation criteria and methods. Future efforts will include coordinating general research and management objectives; complementary efforts in designing and implementing specific monitoring, research and education programs; and sharing scientific and technical information. Each state is eligible for the complete share of federal funding assistance, has its own state funding mechanism, and has its own staff. Scientists from the Chesapeake Bay community will be encouraged to use any combination of the sites in Virginia and Maryland that are suitable for their research. Research proposals will also be solicited for studies involving other Research Reserves in the national system.

The need to develop the Reserve program within the framework of the Chesapeake Bay Program and the Virginia Coastal Resource Management Program

The Reserve program is recognized by the Commonwealth of Virginia and by the executive council of the Chesapeake Bay Program as providing a much-needed element in coastal resource management and the overall Chesapeake Bay restoration program. This management plan identifies the relationship between the Research Reserve program, the Chesapeake Bay Program and the Virginia Coastal Resources Management Program.

The need to provide continuing oversight of program administration and accomplishments

Approximately every three years, NOAA will evaluate the Reserve to assess the effectiveness of the management plan, identify which programs are successful and which are not, and pinpoint better ways to fulfill management objectives. In addition, the Reserve staff will conduct an in-house evaluation of program strengths and weaknesses each year and will revise the management plan every five years.

RESEARCH AND MONITORING AT RESERVE SITES

The need to support long-term studies

Few research programs are endowed with sources of funding for acquiring the long-term data needed to distinguish long-term cycles from unidirectional changes or anthropogenic changes from natural ones (NSF, 1978). Reserve management will strive to establish long-term funding (i.e., longer than the typical one- to two-year funding cycle) and will give preference to investigators demonstrating commitment to long-term studies. An endowment, based on a private gift, has been established, and other sources of long-term funding will be sought from federal, state and local government agencies and the private sector. Reserve management will work with SRD to determine whether or not an application to the National Science Foundation's Long-Term Ecological Research and Land-Margin Ecosystem Research programs should be considered.

The need to develop a monitoring program

As a long-term program of study is being established, resource information for each Reserve site must be assessed to identify gaps in knowledge, as must the types of monitoring programs required to address major ecological issues. Determining what parameters should be measured requires assessing the parameters already being monitored, as well as identifying ecological data not yet being collected that could prove important. Reserve management will identify those needs through a phased monitoring program.

The need to promote non-destructive, non-manipulative research

Because Research Reserves represent natural ecosystems where ecological processes and functions operate without human impact, manipulative research will be emphasized. Certain allowances may be considered when manipulation is necessary to restore degraded areas or to eradicate invasive species.

The need to link the Reserve and the scientific community

Research Reserves are intended to furnish attractive environments for scientific research and serve as scientific controls (i.e., a system of checks and balances) for research conducted in other estuarine environments. Successful implementation of the program is contingent upon the involvement and enthusiasm of the scientific community (House Report 99-103, 1985). By virtue of its headquarters at VIMS, the Reserve will be able to promote awareness of the program and the Reserve sites among scientists, resource management agencies and institutions of higher learning.

The need to provide for the transfer of scientific information to coastal decisionmakers

To improve coastal decisionmaking, an effective mechanism must be established between the Research Reserve and individuals making decisions that affect estuarine resources. The mechanism must involve a two-way exchange of information, to ascertain what problems and information are of greatest priority to coastal managers and to make research results readily available to support decisions regarding estuarine resources (House Report 99-103, 1985). Such a mechanism was used by the Scientific Technical Advisory Committee in preparing the Comprehensive Research Plan for the Chesapeake Bay Program (Chesapeake Executive Council, 1988a) and is used by the Research Planning Committee for the Chesapeake Bay Program. The Reserve used a similar mechanism in developing this management plan and will continue this approach after designation through the implementation of advisory committees and an educational outreach program.

The need to develop and maintain computer-based interactive database and geographic information analysis capabilities

The Research Reserve should develop and maintain computer-based interactive database and geographic information analysis capabilities that are consistent among sites, easily used, and compatible with other computer-based databases and environmental analysis systems used at federal, state and local levels throughout the Chesapeake Bay. Virginia and Maryland should jointly review and evaluate software and hardware system requirements before investing resources in acquisition. This analysis will be conducted before long-term research and monitoring programs are fully initiated.

The need for peer review of proposals and technical reports

Sponsored research must be subject to peer review of the kind characteristic of the National Science Foundation and National Sea Grant. Such careful review will be the best guarantee for success, utility and importance of the research. The Reserve will promote a competitive proposal process and provide suf-

ficient time for proposal preparation and review to ensure that proposals are scientifically sound and are adequately reviewed. The Reserve's peer-review process will be consistent with NOAA guidelines.

EDUCATION, INTERPRETATION AND VISITOR-USE PROGRAMS

The need to tailor education, interpretation and other visitor-use programs to Reserve site needs and constraints

Research Reserves provide excellent opportunities for communicating with the general public about the importance, values and sensitivities of estuarine environments. In general, education, interpretation and compatible types of recreation (e.g., traditional hunting, fishing, canoeing, nature-watching, hiking) are encouraged at Research Reserve sites if they do not disrupt the estuary's natural characteristics or ongoing scientific investigations (House Report 99-103, 1985).

The level of public use proposed herein for the Research Reserve sites has been determined for individual sites by considering: (1) resource sensitivity, such as presence of rare, threatened or endangered organisms; relict, fragile or significant natural communities; or significant archaeological or cultural resources; (2) potential conflict or interference with ongoing research or monitoring; (3) compatibility with existing traditional uses; (4) degree of public access; (5) accessibility; and (6) alternate nearby opportunities for on-site education and interpretation programs.

For sites determined to be suitable for on-site education and interpretation, visitor-use programs will be designed to minimize on-site impacts. Disruption of remote, relatively undisturbed parts of the Reserve sites will be precluded by using existing access areas and trails and limiting wandering and uncontrolled use of sensitive areas. Designated areas will be patrolled periodically and trash and debris removed to discourage littering. Existing access will dictate the nature and distribution of visitor-use programs.

The need to establish a research, education or visitor center as part of the overall Reserve management strategy

NOAA encourages the establishment of research, education or visitor centers within the boundaries of Reserve sites to focus national and local attention on the Reserve; to foster better communication between the Reserve program and the scientific and education communities; and to facilitate on-site research, education and volunteer programs (see Table 11). The centers provide unique means of public access and opportunities for research and education. The Reserve proposes to build or restore a structure to serve as a research and education center at one of the sites.

The need to enhance public awareness of the Research Reserve program and its role in the Chesapeake Bay Program

The Reserve will undertake a campaign to establish its identity for residents and visitors in Tidewater Virginia, the general public, state agencies, and local governments. The Reserve staff will design, distribute and update a brochure, a newsletter, a research prospectus, and other orientation and interpretive publications on the Reserve program and sites. The staff also will work with organizations and agencies with programs on the Chesapeake Bay and its tributaries to encourage them to incorporate or use the Reserve program in their activities. Specific educational and interpretive activities will be directed toward coastal management decisionmakers and individuals or groups that routinely make decisions affecting estuarine and coastal environments.

PUBLIC ACCESS PLAN

BACKGROUND

Section 921.13(a)(5) of the National Estuarine Research Reserve System regulations requires a plan for public access as part of a Reserve's overall management plan. However, the regulations do not specify the public ac-

Table 11
VISITOR CENTER FUNCTIONS

NOAA recommends that planning for research and educational facilities and visitor centers should take into account the following uses.

Administration
Reserve staff offices
Volunteer association office
Reception area
Meeting areas

Research
Working space for guest researchers and research interns
Basic laboratory facilities (wet and dry labs)
Storage area (equipment)
Library

Education and Interpretation
Permanent exhibit areas
Rotating exhibit areas
Information and sales area
Classroom/hands-on discovery room
Auditorium (seating area for educational and interpretive programs)
Outdoor classroom/amphitheater
Walkway to main trailhead

Common Building Areas
Visitor parking
Staff parking and maintenance access
Mechanical area
Electrical room
Washrooms
Utility room

Other
Kitchen
Dormitory

---

cess plan's contents nor the extent to which the Reserve must be available for public visitation. The regulations do state that use levels are set by individual states and that acceptable uses must be consistent with the program mission and goals. Because the Reserve will have a multiple-component design, NOAA has agreed that public access provisions can be tailored site by site (Bohne, 1987). In aggregate, the sites will contribute to balanced access to the whole Reserve system.

A site-by-site assessment of public access levels, areas and schedules has been conducted for each site. Opportunities for public access were evaluated on the basis of the following criteria: sensitivity of resources to human activities; compatibility with research; compatibility with traditional uses; compatibility with adjacent land uses; existing degree of public access; and alternative opportunities for public access within the York River basin. Decisions on access at individual sites also considered the policies of affected landowners.

Public access to Reserve sites will be controlled to protect each site's ecological integrity and provide a stable environment for research. The Reserve will encourage traditional uses that do not conflict with Reserve goals and compatible educational uses that help achieve those goals. Traditional activities will continue at levels permitted at present under local and state laws and under regulations imposed by site property owners. Access rules and schedules will remain valid. For properties that are not adequately protected, VIMS will work with the site property owners and the Reserve's Resource Protection Advisory Committee to develop specific access rules and schedules. VIMS and site property owners reserve the right to impose additional restrictions to curtail any activity threatening to disturb natural conditions or ongoing research and education activities.

ACCESS RULES AND SCHEDULES

The following rules and schedules for public access will be adopted for the York River Reserve sites.

GOODWIN ISLANDS The College of William and Mary maintains a limited-use public-access policy for the Goodwin Islands. In accordance with that policy, the Goodwin Islands are managed exclusively for research and education. However, traditional public uses, such as picnicking, beachcombing, crabbing and fishing, are compatible and acceptable uses if visitors do not willfully or negligently disturb the environment or scientific experiments, poach, or litter. Primitive camping occurs occasionally but is not encouraged because of litter and the threat of fire. In the waters around the Goodwin Islands, fish, oys-

ters and crabs are harvested, and floating duck blinds may be used. No stationary blinds are allowed. The islands are posted every year to ensure that stationary blinds are not erected. Overall, visitor use is minimal.

Permission to visit the Goodwin Islands for research or education purposes is obtained through a permit process conducted by VIMS. The permit application is reviewed by the Goodwin Islands Steering Committee at VIMS, which was set up to coordinate use of the islands, and is approved by the Reserve director. All other activities are controlled by laws and regulations. Under the Reserve program, the Goodwin Islands will continue to be used for research, education and compatible traditional public uses. Proposed research and educational projects must be approved by VIMS through an appropriate advisory committee. The public will continue to use the beach for picnicking, beachcombing and other non-destructive recreation. Primitive camping will be discouraged by implementing a dawn-to-dusk public access policy. VIMS will promote anti-littering and fire prevention through signs posted on the islands and through other appropriate educational media. The public will continue to crab, fish and clam in and around the Reserve in accordance with applicable state laws and regulations. VIMS will continue to purchase and post shoreline duck hunting licenses to prevent the erection of duck blinds. Floating blinds will still be allowed.

Prosecution of violators will serve as a deterrent against vandalism, littering and arson. When warranted, the assistance of state and local law enforcement agencies may be called upon to enforce access policies.

Little increase in public use is expected as a result of the designation of the Goodwin Islands as a Reserve site. The islands are separated from the mainland by water and accessible only by shallow draft boat. There are no docking facilities on the islands.

CATLETT ISLANDS The Catlett Islands are privately owned, and visitation is controlled by the property owners. The only permitted uses are hunting, trapping and non-manipulative research. The islands are posted against trespass. In the waters around the Catlett Islands commercial and recreational fishermen harvest fish and crabs in accordance with state laws and regulations. The property owners reserve the right to continue to harvest oysters.

The portions of the Catlett Islands within the Reserve will be managed exclusively for research and existing traditional uses. Research projects must receive permission from VIMS and the Reserve's Research and Monitoring Advisory Committee. Research use will be limited to the period between dawn and dusk (except under special-use permits to study nocturnal organisms) and confined to specific areas. Hunting, trapping and oyster-gathering are the exclusive rights of the property owners and their assigns. Commercial and recreational fishing and crabbing will continue in accordance with laws and regulations. To preserve the pristine yet fragile environment of the Catlett Islands and promote use for long-term ecological research, general public access will not be allowed.

Primary access to the islands will continue to be by water. Each request for limited access by land over existing roads will be considered by the landowners and Reserve manager. Research activities may continue during hunting season with the permission of landowners.

No increase in public access is expected as a result of designation as a Research Reserve site. The number of research projects is anticipated to remain at its present level of two to three projects a year.

Designation of the Catlett Islands component of the Reserve will not restrict the landowners' ability to use lands outside of the Reserve boundaries for traditional uses or as they may use the uplands in the future consistent with local ordinances. Present uses include crop farming, livestock raising, tree farming, hunting, trapping and residential use. Future uses may include expansion or retirement of cropland or pasture and timber harvest. These activities should not impact the Catlett Islands.

When warranted, the assistance of state and local law enforcement agencies will be called upon to enforce access policies. Close association with affected property owners should help prevent major trespass problems.

TASKINAS CREEK Because Taskinas Creek is part of York River State Park, access is controlled by park regulations and at Taskinas Point is allowed from 8 a.m. to dusk. Croaker Landing can be used for boating 24 hours a day; a 10 p.m. closing time is posted and enforced for non-boating activities there. The eastern portion of Taskinas Creek within the park is used for passive recreation and nature study. Visitors are encouraged to use self-guided hiking trails, bridle trails and designated picnic areas and to participate in guided canoe trips. Canoeing other than the guided canoe trips is permitted. Access to the western portion of Taskinas Creek is not encouraged. The park maintains a locked gate at an old fire trail on Route 605, but access is not expressly restricted. Although the park recognizes the sensitive nature of some areas within the western portion of Taskinas Creek, passive recreation is not restricted as long as visitors adhere to environmental constraints. Access is not, at this time, controlled through a permit system. Other sections of the park provide public access for fishing, boating (including boat ramp and parking), horseback riding, and other recreation-related purposes.

The park is open year-round, but the visitor center is closed in winter. The park charges a nominal fee for canoe trips, picnic shelter rentals, parking and brochures. Special-use permits are required for other-than-traditional uses (e.g., research, field trips and special events). Prosecution of violators serves as a deterrent against poaching, illegal use of off-road vehicles, vandalism and littering.

Under the Reserve program, park regulations, use restrictions and permit process affecting Taskinas Creek and its watershed will remain in effect to preclude degradation of the Reserve's wetlands and adjacent environments. The eastern portion of the Taskinas Creek watershed will remain accessible for appropriate educational and recreational uses, as well as for approved research and monitoring. The Reserve will use the western portion of the watershed for research and nature study; however, this area will not be placed under a more restrictive access policy at this time. This western portion of the watershed has limited capabilities due to limitations of steep slopes and moderately to highly erodible soils. Much of this area has been preliminarily classified as sensitive and special land by the Department of Conservation and Recreation, reflecting the capabilities of the area. The department's Natural Heritage Program has indicated that this western portion is being evaluated for designation as a natural area. Therefore, some areas of the western portion of the park may be placed under restrictive access at some time in the future. The Reserve will review park permit applications for Taskinas Creek.

Some increase in public use of York River State Park is expected with the designation of the Taskinas Creek Research Reserve site because the Reserve will actively promote the appropriate portions of Taskinas Creek for passive recreation, nature study and research. However, this increase should not adversely affect the resources of the park or the Reserve. An increase in public use also may result if a research and education center is built within the buffer zone of the Reserve on the eastern side of Taskinas Creek.

In a recent assessment of land suitabilities within the park, the eastern section of Taskinas Creek was classified as suitable for existing public access. It was determined that this area could withstand increased visitor use without concomitant adverse impacts. On the other hand, because of resource sensitivity, the western portion of Taskinas Creek was deemed unsuitable for development of public access facilities (Department of Conservation and Recreation, 1989).

Public education, along with close association with nearby property owners, should help prevent major trespass problems. The park will continue to enforce park regulations and prosecute violators.

SWEET HALL MARSH Like the Catlett Islands, Sweet Hall Marsh is pristine and very sensitive to human disturbance. The property is owned by the Tacoma Hunting and Fishing Club and is used by the club for hunting, fishing and trapping. The club has given VIMS permission to conduct non-destructive research in a portion of the marsh since 1984. In the waters around Sweet Hall Marsh, hook-and-line fishing, drift-net fishing and pot-fishing (for eels) are practiced. On the uplands above Sweet Hall Marsh, the club and the adjacent landowner, Chesapeake Corporation, control access and allow hunting by permit.

Under the Reserve program, public access to Sweet Hall Marsh will not be allowed in order to protect this fragile environment and ongoing research efforts. No significant increase in research visitation to Sweet Hall Marsh or adjacent bottomland hardwood forest is expected as a result of designation as a Reserve site. During an average year, as many as six concurrent research projects and two educational field trips may be underway at Sweet Hall Marsh. In addition, weekly water quality samples are collected from the club's dock on the Pamunkey River. Research and educational uses of Sweet Hall Marsh will require permits issued by the Reserve.

Research will be eliminated in the interior of the marsh at least two weeks before duck season begins each year, and any barriers (e.g., the catwalk over Club House Creek) restricting access to the interior of the marsh will be removed during duck season.

This management plan includes a proposal to upgrade the boat launching area to enable researchers to deploy small, trailerable research vessels (Jonboat or Privateers). The ramp will not be available for public use. The dirt road leading from Route 637 to the launching area is private and will be chained and locked below the clubhouse following designation.

Designation of Sweet Hall Marsh as a Reserve site will not restrict the club's or Chesapeake Corporation's ability to use the uplands above the marsh for traditional uses or as the Club or Chesapeake may use the uplands in the future consistent with their conservative and environmentally sensitive past practices and applicable state or local regulations. Current uses include crop farming, tree farming, hunting, trapping, and use of off-the-road vehicles. Future use may include clearing for cropland, pulpwood harvesting, construction of a new hunting lodge, and construction of a small pond in the goose field behind Club House Creek. The uplands are in the buffer zone and the activities could be monitored for possible environmental impact.

RESEARCH AND MONITORING PLAN

RESEARCH PRIORITIES

The development of a research and monitoring plan for the Reserve presented a formidable challenge in that such a plan must address national, Bay-wide, Reserve-wide, and site-specific research and monitoring needs. Fortunately, plans identifying national and Bay-wide research and monitoring priorities have been prepared (NOAA, 1987b; Chesapeake Executive Council, 1988b). Therefore, preparation of this plan required determining only which national and Bay-wide priorities are appropriate for consideration at the York River Reserve sites and what additional York River system-wide or site-specific projects are needed. To accomplish this, the Reserve solicited input from state resource management agencies, affected county governments, and individual scientists.

National Priorities for the National Estuarine Research Reserve System

Although large data sets exist for many of the fundamental processes of estuaries, there are significant gaps in the information needed to understand the complex functions of most estuaries (NOAA, 1987b). To address that issue, some of the nation's most capable estuarine scientists gathered in 1984 to review the existing state of knowledge on the nation's estuaries. From that assessment, SRD compiled a list of national research needs. In or-

der to qualify for SRD funding, the Reserve's research proposals must address one or more of the national priorities. These research priorities are related to improving understanding of the following:

WATER MANAGEMENT Research on the functional relationships between freshwater inflow, salinity regimes, nutrient dynamics, coupling of primary and secondary production, maintenance of wetland and aquatic communities, and responses and recovery of estuaries to changes in freshwater inflow;

SEDIMENT MANAGEMENT Research on sediment dynamics (delivery, accumulation, composition, and absorption and desorption of contaminants); sedimentation impacts to flora, fauna, water quality, primary production and habitats; and resilience and recovery of estuaries to sedimentation events;

NUTRIENTS AND OTHER CHEMICAL INPUTS Research on short- and long-term responses of estuaries to nutrient inputs and recycling, synthetic chemicals, and exotic materials;

COUPLING OF PRIMARY AND SECONDARY PRODUCTION Research on quantitative relationships between primary and secondary production, comparative trophic importance of vascular plants vs. planktonic organic matter, fisheries utilization of detritus as a food source, and impact of detritus-producing wetland and seagrass bed acreage and quality reduction; and

ESTUARINE FISHERY HABITAT REQUIREMENTS Research to characterize estuarine fishery habitat, nursery, food, hydrological, and hydrodynamic requirements.

In addition to these areas, SRD recognizes the need for site-specific baseline information and lists the following research areas as being appropriate for national funding. The first two priority areas are also priorities under the SRD phased monitoring program.

INITIAL BASELINE SURVEYS Baseline surveys to fill information gaps and better characterize the sites' resources, environment and ecology;

ENVIRONMENTAL MONITORING Systematic periodic monitoring of selected parameters to provide a database for detecting changes, predicting impacts, and identifying correlations with other observed phenomena; and

SPECIAL STUDIES Special studies to answer specific management questions and improve coastal resource management.

The rationale for these research priorities is described in the National Estuarine Research Reserve System Research Plan (NOAA, 1987b). Each year SRD issues a National Estuarine Research Reserve System Research Opportunity Announcement in which it elaborates on the latest interpretation of these priorities. Proposal funding decisions are based on the relationship between the proposed research and these national priorities.

Chesapeake Bay Program Priorities

In 1983, Virginia, Maryland, Pennsylvania, the District of Columbia, the U.S. Environmental Protection Agency and the Chesapeake Bay Commission formally agreed to coordinate interstate planning and programs for the Chesapeake Bay and its tributaries and established mechanisms to facilitate that coordination. Since 1983, this joint commitment has led to new levels of government cooperation, including a new, more comprehensive Chesapeake Bay Agreement by the Chesapeake Executive Council in 1987, which promises accelerated advances in the Bay's restoration and protection. Also since 1983, scientific understanding of the Bay, its resources, and its problems has improved.

While much has been learned about the Chesapeake Bay in recent years, significant information gaps remain in our understanding of the ecosystem. In particular, the ability to answer managerial questions on the basis of sound interdisciplinary data is frequently lacking. These shortcomings have been described by several authorities:

> One of the primary problems we face in addressing degradation of coastal waters is the fact that we know too little about them. We need to increase our knowledge of the various pollution sources and how each of these sources, alone or in combination, affects our coastal resources (EPA, 1989a).
>
> Our current understanding of the Bay must be tempered by the realization that estuaries are our

> most complex aquatic environment...basic tenets of oceanography or limnology do not necessarily hold in the estuary (Chesapeake Executive Council, 1988a).
>
> Estuarine science has suffered from sociopolitical pressures to restrict research in estuaries to applied, relevant and responsive programs, often without concern for the real scientific problems...Chesapeake Bay has not escaped this constraint (Chesapeake Executive Council 1988a).
>
> Many of the important first-order disciplinary (i.e., purely biological, chemical, geological, or physical) scientific questions on estuaries have been addressed; few of the second-order disciplinary questions have been considered; and almost none of the most important, complex interdisciplinary questions that relate to the interactions of the physical, chemical, biological, and geological processes have been studied. It is this level of understanding which is required for effective management (Schubel, 1986).

We are fortunate in that much of what is learned in one estuarine system has some relevance in other estuarine systems. We have, however, determined that each estuarine system taken in its entirety has unique characteristics that must be understood if we are to manage that system (Chesapeake Executive Council, 1988a).

To address data and information gaps, the Chesapeake Executive Council published a Comprehensive Research Plan for the Chesapeake Bay Program in 1988. The plan was developed using input from:

- More than 350 questionnaires sent to scientists and resource managers in the Bay region soliciting recommendations for specific research or statements of information needs specific to the objectives and commitments in the 1987 Chesapeake Bay Agreement;
- A research conference that addressed the understanding of estuarine processes in several areas critical to Bay management; and
- A subcommittee of the Scientific and Technical Advisory Committee that reviewed detailed research needs, research plans, and management issues submitted by a number of institutions.

The result of this effort was two-fold, a comprehensive list of research needs associated with specific objectives and commitments of the 1987 Bay Agreement and further analysis and refinement of these needs into research needs and priorities. In order to receive Reserve approval, research at designated sites must fulfill one or more of the Chesapeake Bay Program research priorities. In addition, data generated through the Reserve's research and monitoring will be made available to the EPA's Chesapeake Bay Liaison Office to support other Bay research and monitoring programs. The following Bay research priorities will be encouraged at Reserve sites, as appropriate:

INITIAL SHORT-TERM PRIORITIES Research to provide management information on sediment/water-column nutrient flux; evaluation of BMP effectiveness; analysis of living resource data sets; stock assessments; evaluation and analysis of monitoring capabilities; and sublethal responses to toxins.

LONGER-TERM PRIORITIES Fundamental research on circulation and mixing processes; water quality, habitat and ecosystem-level models; interactions between various trophic levels (particularly pelagic in communities); genetic makeup of living resources (particularly for exploitable stocks); significance of groundwater flow and contamination; and impacts of specific land uses on aquatic, wetland and riparian habitats.

RESEARCH SUPPORT PRIORITIES Support related to preparedness to conduct research, including advanced analytical chemical equipment (particularly for identification of organic and metallo-organic compounds); remote sensing; and automated data analysis technologies.

GENERIC, LONGER-TERM NEEDS Research related to improved understanding of structure and function of coastal habitats (submerged aquatic vegetation, emergent saline marshes, tidal freshwater habitats, nonvegetated wetlands, benthic habitats, oyster reefs); impacts of modification of coastal and contiguous habitats; water column processes (related to plankton communities, inorganic nutrient cycling, replenishment and storage, micro-circulation, and interactions among mainstem and adjacent water bodies); toxins; circulation (in relation to eddies, fronts, plumes, wind, anoxia, and transport of plank-

tonic larvae); genetic variability and structure of Chesapeake Bay stocks; watershed processes (including transport, fate and processing of dissolved and particulate material; effects of land use; role and extent of water transport and transformation above the fall line; and role of wetland and riparian zones in controlling or modifying discharge); groundwater contribution (including spatial and temporal input and outflows; chemical characteristics, extent and magnitude of pesticide, nutrient and other pollutant contamination; impact on sediment-water column pollution interactions; and methods to reduce groundwater pollution); social, legal and economic implications of alternate restoration and preservation strategies; impacts of population growth development; public health and the Chesapeake Bay ecosystem; and structure, function, and role of non-tidal wetlands.

System-Wide Research Priorities

VIMS convened a workshop in September 1989 to identify basic and applied research needs for the Reserve. At the workshop, a list of research needs was generated and later, through direct mail to workshop participants, the list was reviewed and arranged in priority order. The complete list, with cross-references to agency/county interest and projects for possible cost-sharing, was presented as Appendix F of the combination Final Environmental Impact Statement/Final Management Plan (Chesapeake Bay National Estuarine Research Reserve System in Virginia, 1991). The top priority projects are listed below. Some of these projects are already in progress or have been completed as pilots at Reserve sites. Research approved for state or federal funding at Reserve sites in the first five years of operations must address one or more of the priorities listed below:

Basic Research Priorities

Some baseline data on water quality, geology, flora and fauna at or near Reserve sites exist. Additional information is needed to provide a more thorough characterization of the sites and the York River system in the following areas:

Complete inventory of flora and fauna;

Monitoring of selected flora and fauna (including aquatic vegetation, wetland and forest species, fish stocks, and undesirable and exotic species) and their habitats;

Baseline assessment and monitoring of nutrient, chemical and sediment loading to surface waters and their impacts to living and non-living resources;

Characterization of background water quality, surface water and groundwater interchange, and groundwater flow from shallow-water to deep-water aquifers; and

Developing a correlation between critical habitat requirements, minimum instream flow and salinity requirements, and water quality conditions.

Applied Research Priorities

Research needed to improve coastal management decisionmaking in the York River basin includes:

Quantifying the affects on coastal habitats and fisheries of freshwater withdrawal, salinity intrusion, sea level rise and subsidence;

Quantifying the effectiveness of forested and agricultural buffer zones and other BMPs, including the value to water quality, flood control, sediment stabilization and wildlife;

Identifying criteria and standards for mitigation by using Reserve sites as controls for off-site mitigation projects;

Assessing impacts of land development (residential, commercial, roads, parking lots, etc.) on flora and fauna;

Re-establishing submerged aquatic vegetation; and

Monitoring toxic contaminants in fish and wildlife in pristine Reserve sites for comparison with levels in organisms in contaminated areas.

Miscellaneous Studies

DATA AND INFORMATION MANAGEMENT SYSTEM A study is recommended that will determine the needs for data and information analysis for monitoring resource and development issues affecting Reserve sites. Needs also should be assessed for hardware and software for geographic informa-

tion mapping and analysis, remote sensing, data logging, and resource management applications.

CULTURAL AND HISTORICAL RESOURCE SURVEY Reserve sites offer opportunities for studies on the history of settlement and commerce in the York River basin. Studies to reconstruct the history of land use, ownership, mining, farming, fishing, hunting and recreational use of Reserves are recommended, as are archaeological surveys of probable locations for terrestrial and subaqueous artifacts from pre-historic times through the present.

Site-Specific Research Priorities

The York River Reserve sites have a history of ongoing research. New and follow-up studies are needed to improve scientific understanding of the sites and to address site-specific management issues. These needs are as follows:

Goodwin Islands: Basic Research Priorities

VEGETATION HABITAT MAPS A checklist of vascular plants by habitat has been prepared, and the location and size of submerged aquatic vegetation beds have been mapped and are monitored. Follow-up studies are needed to map and quantitatively analyze wetland and upland plant community structure and site conditions. Studies of submerged aquatic vegetation should continue. The long-range objective is to assess habitat conditions, presence of sensitive, rare or endangered plant species, and areas of resource degradation or introduced plant species. A program should be developed to monitor community conditions over time in relation to erosion, sea level rise and other coastal events.

SURVEY OF FAUNA An inventory and quantitative assessment of insects, reptiles, amphibians, birds and mammals is needed. A survey of invertebrates, finfish and turtles in the waters within the site is desirable. The long-range objective is to determine and monitor population densities, distribution, dynamics, conditions and habitat requirements.

COASTAL GEOLOGY Preliminary studies on the geology and origin of the islands, erosion problems, and impacts of sea level rise have begun and should be expanded to produce a geological map, current estimates of island loss from erosion, and benchmarks for monitoring sea level rise.

WATER RESOURCES Data on the quality of surface water and groundwater resources are needed to monitor conditions and detect pollution occurrences.

AIR QUALITY Baseline air quality data assessment and monitoring are needed to detect pollution.

Goodwin Islands: Applied Research Priorities

EFFECTS OF FIRE ON ISLAND ECOLOGY Studies continue on the recovery of the high marsh from the 1986 fire. Follow-up studies could include comparison with the effects of fire in other types of marsh (e.g., freshwater) or the use of fire as a management tool (e.g., for restoration purposes).

NATIVE VEGETATION RESTORATION A study on the invasion and spread of *Phragmites australis* is in progress and should continue. An assessment is needed of other undesirable plant species and their impacts on native species. The long-range objective is to provide recommendations on the control and eradication of noxious plant species and protection and re-establishment of native species.

ESTUARINE DEBRIS MONITORING Much estuarine debris accumulates on the beaches and in high marshes of the Goodwin Islands. A project is underway to remove this debris and monitor future accumulation.

VISITOR-USE SURVEY A survey is needed of public use of the islands.

BOATING TRAFFIC ASSESSMENT A study is recommended of the amount and potential environmental impacts of vessel traffic in the York River and Sandbox Thorofare (e.g., estuarine debris, oil spills).

EMERGENCY RESPONSE CAPABILITIES The Reserve needs to be prepared to deal with environmental and human emergency situations on and around the islands, including oil and hazardous material spills, wildfire, floods, boating mishaps, and marine mammal strandings.

Catlett Islands: Basic Research Priorities

VEGETATION SURVEY AND HABITAT MAP A preliminary inventory of wetland and upland plants has been conducted and a quantitative assessment of community structure has begun. This research should be continued with the goal of producing a complete species list; a habitat map of the Reserve site; and an assessment of habitat conditions, presence of sensitive, rare or endangered plant species, and areas of resource degradation or introduced plant species. A monitoring program should be developed to monitor community conditions over time in relation to erosion, sea level rise, and other coastal events.

SURVEY OF FAUNA Monthly surveys of bird life on one of the Catlett Islands is being conducted and should be continued and expanded. An inventory and quantitative assessment is needed of insects, reptiles, amphibians and mammals, as well as a survey of invertebrates, finfish and turtles in the waters within the Reserve site. The long-range objective is to determine and monitor population densities, distribution, dynamics, conditions and habitat requirements.

COASTAL GEOLOGY Studies are needed on the geology and origin of the Catlett Islands, past and present shoreline erosion problems, and rate and impact of sea level rise.

WATER RESOURCES Water quality in Timberneck and Cedarbush creeks is being monitored by citizen volunteers. This study should be continued and expanded to include additional parameters and additional stations in Poplar Creek.

AIR QUALITY Baseline monitoring of air quality is needed to detect pollution and determine its effects on island resources.

Catlett Islands: Applied Research Priorities

EFFECTS OF FORESTED BUFFER STRIPS ON ESTUARINE WATER QUALITY A pilot study was conducted on Timberneck Farm to assess the usefulness of forested buffer strips as natural controls to reduce waterborne inorganic nutrient fluxes from agricultural fields to adjacent water bodies. A slightly different approach should be undertaken to measure buffer strip performance in both time and space and to evaluate the effectiveness of forested buffers for controlling nutrient input to coastal waters from nonpoint agricultural sources.

SHELLFISH ENHANCEMENT Shellfish growing areas in Cedarbush and Timberneck creeks and around the Catlett Islands should be studied to determine the effects of land use on shellfish production and sanitation, rates of natural shellfish purification, and the feasibility of rack relay and rack culture techniques.

RE-ESTABLISHMENT OF SUBMERGED AQUATIC VEGETATION A project is warranted to re-establish and monitor seagrasses in areas around the Catlett Islands that no longer support submerged vegetation.

BOATING TRAFFIC ASSESSMENT A study is recommended on the amount and potential environmental impacts (e.g., estuarine debris, oil spill) of vessel traffic in Timberneck, Cedarbush and Poplar creeks and adjacent stretches of the York River.

Taskinas Creek: Basic Research Priorities

SURVEY OF FLORA Baseline studies on the floristics of brackish and freshwater marshes, bottomland hardwood forests, and upland ridge tops and slopes need to be completed. A quantitative assessment of community structure is needed. The long-range objective is to produce a complete species list; a habitat map of the Reserve; and an assessment of habitat conditions, presence of sensitive, rare or endangered plant species, and areas of resource degradation or introduced plant species. A monitoring program should be developed to monitor community conditions over time in relation to beaver activity and residential development in the watershed.

SURVEY OF FAUNA An inventory and quantitative assessment is needed of the insects, reptiles, amphibians, birds and mammals of Taskinas Creek and its watershed, as is a survey of marine invertebrates and finfish in the waters within the Reserve site. The long-range objective is to determine and

monitor population densities, distribution, dynamics, conditions and habitat requirements.

COASTAL GEOLOGY A geologic map and a radon study for the park have been completed. Follow-up work is needed on sedimentation processes, erosion problems, and sea level rise patterns in Taskinas Creek.

WATER RESOURCES A study is in progress to establish baseline surface and subsurface water quality conditions in the Taskinas Creek watershed. A strategy is needed for long-term monitoring of water quality.

AIR QUALITY AND METEOROLOGICAL CONDITIONS Baseline monitoring of air quality and weather patterns is needed.

Taskinas Creek: Applied Research Priorities

CARRYING CAPACITY A study is needed to establish the carrying capacity of the Reserve site to accommodate public use, research and education.

IMPACTS OF RUNOFF FROM PARKING LOTS A study is recommended to assess the impact of runoff from parking lots in York River State Park.

SHELLFISH ENHANCEMENT An investigation is needed of the viability of shellfish growing areas in Taskinas Creek and the possibility of enhancing shellfish recruitment to historical beds.

BOATING TRAFFIC ASSESSMENT A study is recommended on the environmental impacts on the York River shoreline and fringing marshes of improvements to the Croaker Landing boat ramp and associated increased boat traffic.

Sweet Hall Marsh: Basic Research Priorities

ECOLOGY OF TIDAL FRESHWATER WETLANDS The floristics, productivity and community structure of the freshwater marsh have been studied and should be updated periodically to monitor their status and trends in relation to sea level rise, subsidence, freshwater flow regimes, and other natural and human-induced processes. A plant inventory is needed for plants in the bottomland hardwood swamp, upland-wetlands transition areas, and uplands (pine plantation and mixed hardwood forest). Also needed are studies of salinity tolerances of freshwater wetland plant species (especially rare and endangered species). Studies are recommended to examine the role of non-tidal wetlands and the link between anadromous fishes and marshes. Habitat maps and monitoring programs are needed to analyze changes in community structure over time.

SURVEY OF FAUNA Inventory and quantitative assessment are needed for insects, reptiles, amphibians, birds, mammals, shellfish and finfish at Sweet Hall Marsh. The long-range objective is to determine and monitor population densities, distribution, dynamics, conditions and habitat requirements.

BENTHIC STUDIES A study is recommended to assess benthic populations, community structure, and relationship with fisheries and waterfowl production.

MUSKRAT POPULATION STUDY The Sweet Hall Marsh muskrat population and its impact on the marsh system should be studied. The population of muskrat dens was mapped in 1986-87, and preliminary impacts on vegetation and hydrology were studied. This study should be expanded.

GEOLOGY An investigation is needed of the geology and origin of Sweet Hall Marsh. A preliminary soils map has been prepared, and preliminary studies have been undertaken on sedimentation rates and patterns and groundwater hydrology. These studies need to be expanded.

WATER RESOURCES Water quality in the Pamunkey River near Sweet Hall Marsh is being monitored, and this study should be continued. A net flux study in Club House Creek has been completed and the data are being analyzed. A study has been undertaken on groundwater flow dynamics and its role in pore water chemistry and nutrient exchange with adjacent surface water. Follow-up studies may be warranted to examine the relationship between surface and ground waters and their role in wetlands ecology. Studies on minimum instream flow requirements are needed, as are studies on the role of wetlands in nutrient dynamics of tidal freshwater reaches.

AIR QUALITY AND METEOROLOGICAL CONDITIONS Baseline monitoring of air quality and weather patterns is needed.

Sweet Hall Marsh: Applied Research Priorities

EFFECTS OF FORESTED BUFFER STRIPS ON ESTUARINE WATER QUALITY A study is recommended on the usefulness of bottomland forests as natural controls to reduce runoff from clearcut operations and waterborne chemicals from agricultural fields.

BOATING TRAFFIC ASSESSMENT A study is recommended on the environmental impacts of boat wake in the Pamunkey River and in the thoroughfare on Sweet Hall Marsh.

ROLE OF PHYSICAL AND BIOLOGICAL FACTORS ON THE STABILITY AND VIABILITY OF FRESHWATER WETLAND ECOSYSTEMS Studies are needed to assess the impacts of freshwater withdrawal, salinity intrusion, subsidence, sea level rise, sedimentation, erosion, muskrat activity, boat wake, timber management, and agricultural practices on the ecology of freshwater marshes and forested wetlands in the Pamunkey River basin. A predictive, interactive model of the Pamunkey River basin is needed to help resource managers assess the implications of proposed and potential activities.

MONITORING

In 1989, SRD initiated a phased monitoring program to help National Estuarine Research Reserves improve understanding of the estuarine resources being managed under the national System (Uravitch, 1989a). The monitoring program, as defined by SRD and modified by the Reserve program, will include the following phases:

ENVIRONMENTAL CHARACTERIZATION Literature review and field research to acquire all available information on hydrology, geology, water chemistry, water quality, biological resources, and the problems and issues confronting the Reserve environment;

SITE PROFILE During environmental characterization, synthesis of information gathered to provide an overall picture of the Reserve site in terms of resources, issues, management constraints and research needs;

PROCEDURES AND REQUIREMENTS Identifying parameters to be measured, procedures to be used, criteria for measurements, quality control, and standard procedures (where they already exist), sampling strategies for selected parameters (spatial and temporal intervals), storage and retrieval of data (reporting, formatting and analytical requirements), labor requirements, logistics, and cost; and

IMPLEMENTATION Pilot projects followed by full-scale implementation.

The Reserve program's phased monitoring program will be integrated with the Chesapeake Bay Program's monitoring program for water quality, submerged aquatic vegetation, benthic organisms and other living marine resources, toxins, and other parameters (Chesapeake Executive Council, 1988b; State Water Control Board, 1987). It also will be integrated with other monitoring programs of the Commonwealth, including fisheries harvest (Virginia Marine Resources Commission), shellfish sanitation (Department of Health), game and non-game fish, waterfowl, and wildlife species (Department of Game and Inland Fisheries), and rare and endangered plants and animals (Natural Heritage Program, Department of Agriculture and Consumer Affairs and Department of Game and Inland Fisheries). Once baseline conditions are established, many of the baseline parameters listed under Basic Research Needs probably will be integrated into a monitoring program.

The Reserve's phased monitoring program will be developed following SRD guidelines and by consulting the National Science Foundation's *Long-Term Ecological Measurements* plans (NSF, 1978; 1979; 1981; and later issues). Workshops will be convened to assist in the development of the monitoring program and its direction.

RESEARCH POLICIES AND PROCEDURES

Types of Proposals

Research opportunities at Reserve sites will be available to any qualified scientist, academician or student affiliated with any university, college or school; any non-profit, non-academic research institution (e.g., research laboratory, independent museum, professional society); any private profit organization; and any state, local or federal government agency. Unaffiliated individuals who have the capability and facilities needed to perform the work also may qualify for research funds.

Proposals for research at Reserve sites fall under one of several categories as defined below:

Competitive proposals solicited for peer review as a result of SRD and other federal or international announcements of research opportunities;

Non-competitive proposals solicited from only one source when no other source has the needed capability or experience; and

Unsolicited proposals submitted by qualified prospective investigators or students for partial fulfillment of thesis, dissertation, independent problems course, or class project requirements.

Funding

Funding for Reserve research will come from:

SRD funding for national research priorities for the National Estuarine Research Reserve System (matched by applicant; approximate range of funding between $10,000 and $50,000 per year per project);

Funding from other federal sources, including other divisions of NOAA (e.g., Coastal Programs Office, National Marine Fisheries Service, National Sea Grant Program, National Status and Trends Program, National Climate Program, National Marine Pollution Program); National Science Foundation; Environmental Protection Agency; U.S. Department of Agriculture, Soil Conservation Service; U.S. Department of the Interior, Fish and Wildlife Service and Geological Survey; and other relevant funding agencies;

Funding from international sources, including the United Nations Man and the Biosphere Program, Food and Agriculture Organization and UNESCO;

Funding from the Virginia General Assembly, the Virginia Chesapeake Bay Program, the Virginia Coastal Resources Management Program, state resource management agencies, and localities, including in-kind cost-sharing; and

Funding from private individuals, non-profit organizations or foundations, such as the Virginia Environmental Endowment, The Nature Conservancy, Chesapeake Bay Foundation and Alliance for the Chesapeake Bay.

Agencies planning to conduct research in state waters (i.e., that portion of a Reserve site lying below mean low water) should notify Reserve management in advance to ensure coordination between the funding agency, principal investigator and the Reserve. A procedure to ensure adequate notification and coordination will be developed.

The Reserve will develop a research prospectus to provide basic information on Reserve sites. The prospectus will include, for each site, a brief ecological description, a list of unique or unusual features, a list of available research support facilities and equipment, and a list of previous research and published reports.

Research Announcement and Prospectus

SRD develops and distributes an annual announcement of research opportunities that reflects priority research needs. The announcement contains specific statements about the types of research that will be funded; clear and specific guidelines for proposal preparation; clear statements on the procedures and criteria used in proposal review; the level of funding available; and a schedule of the proposal process.

The Reserve will provide SRD with a distribution list for the annual research announcement and will help review proposals. The list

will include local, state and regional entities covering all eligible potential applicants listed above.

The Reserve will develop a Request for Proposals for research funds received from sources other than SRD. The Reserve's RFP and timetable will be similar to SRD's, with a list of research needs, guidelines for submission of proposals, and information on the peer-review process.

Annual Proposal Timetable

The SRD proposal process, which begins with the call for proposals and ends with an award, takes approximately one year to give sufficient time for states to circulate research announcements, investigators to develop detailed proposals, and reviewers to conduct adequate reviews. As a result, projects funded by SRD are scientifically sound, contribute to existing knowledge, are relevant to current coastal management issues, or are adequately funded, directed, or staffed. Although it may vary slightly from year to year, the schedule is as shown in Table 12.

Proposal Review

All proposals received by SRD are peer-reviewed through a direct-mail process involving recognized scientists and resource managers. Project selection is based on several criteria, including scientific merit; importance to Reserve management and regional coastal management issues; relevance to national research priorities; technical approach; qualifications of the principal investigator and key personnel; institutional support and capabilities; and budget.

Reports

SRD requires investigators to submit quarterly and final reports. Reports will include a list of milestones reached; summary of data gathered (but not raw data); list of analyses completed; problems with labor, schedule, budget or technical approach; any impact of problems on future milestones; solutions to problems; summary of next planned work; and problem areas for discussion.

Table 12
RESEARCH PROPOSAL TIMETABLE, FY 1991

JUNE 1990 SRD announcement distributed

SEPTEMBER 1990 SRD received proposals from prospective investigators and selected peer review panels

DECEMBER 1990 SRD received peer review comments

APRIL 1991 SRD awards grants

Final reports must be received by SRD within three months of completion of the research. Detailed instructions for preparing final reports are set forth in SRD requirements and are furnished at the time of the award. Investigators also will submit final reports to the Reserve.

Final reports will include both technical and administrative sections. Technical sections include abstract; objectives; literature review; methods; results; conclusions; and significance to local, regional, state or national management issues. Administrative reports include a project summary in non-technical language; any objectives not attained; scientific publications and presentation of results; application of results; and summary of expenditures. Outstanding reports are published as part of the VIMS series, Special Reports in Applied Marine Science and Ocean Engineering.

The Reserve will strongly encourage the presentation of research results at meetings of appropriate professional societies, such as the Virginia Academy of Science, National Estuarine Research Federation and American Society of Zoologists.

RESEARCH SUPPORT

As manager of the Reserve, VIMS can provide, on a cost-reimbursable, space-available basis, some of the support required for ongoing research. That support includes use of the VIMS physical plant, laboratories, analytical and sampling equipment, and vessels described in the Facilities Development Plan, as well as use specific equipment acquired for the Reserve (see Table 13). A reference

Table 13
RESERVE EQUIPMENT INVENTORY

Photographic
Nikon 20/20 35mm camera with Nikon lenses AF Micro 55mm; 52mm; and AF 70-210mm
Camera cleaning kit
Kodak Ektagraphic III B Slide projector
Kodak carousels (4)

Field
Machetes (2)
Soil sampler (1)
Munsell soil color chart (1)
Brunton compass (1)
Nikon binoculars
Refractometer
Repel bug repellant
Camp shovel (1)
Orange safety vest (XL, L, M)
Hip waders (size 6, 7, 10)
PVC transect pipe
Bitterlicks (5)
Transect measuring tape (100 m)
Topographic quadrangle maps for all coastal counties
Nautical charts
Orange flags on 24" sticks
Flag carrier
Temperature-compensated salinity refractometer
Aluminum calipers
Clinometer with rangefinder
Panasonic microcassette recorder
Azel 20" tree pruning sawhead
Round point shovel
Canvas tool bag

Computer
Zenith Systems XT personal computer, with 20-megabyte hard disk with 1.2-megabyte and 360K, 5.25-inch diskette drives
Zenith Systems Laptop Supersport microcomputer, with 30-megabyte hard disk and 640K, 3.5-inch diskette drive
Hewlett Packard DeskJet printer
Apple Macintosh SE computer
Okidata 292 Microline printer
Hewlett Packard Laserjet III printer

Drafting
Light table
Drafting table
Drafting stool
Planimeter

Herbarium
Smithsonian-type New York Botanical Garden mounting paper
University of Oregon-type herbarium glue
White gummed cloth tape
Standard plant press (5)
Standard driers
Standard ventilators
Botany paste, Model 3140

library has been established. VIMS students may borrow field equipment and books for use in Reserve-related research. Additional computer hardware and software, field equipment, and other forms of research support will be acquired as the need arises and funds are available.

INFORMATION DISSEMINATION

Both SRD and the Reserve encourage the dissemination of research results via:
Journal articles;
SRD-written synthesis of technical reports;
Presentations at professional societies; and
Special symposia arranged by SRD or Reserves, often in association with other meetings, such as the biennial meetings of the Estuarine Research Federation or Coastal Zone Managers.

In addition to SRD's information dissemination routes, the Reserve will use several state and Bay-wide avenues of information exchange including:
Reserve-generated summaries of Reserve research;
Workshops and conferences at Reserve sites, sometimes with funding assistance from SRD;
Reserve information brochure, distributed with the annual call for proposals;
Press releases to local media;
Articles in journals of national scientific societies and local organizations;
Monthly announcements in the Alliance for the Chesapeake Bay's *Virginia Rivers Report*;
Direct mailings to local and state decision-makers; and
Updates to the *Chesapeake Bay Bibliography* and other electronic bibliographies (e.g., *Dialogue, Aquatic Sciences* and *Fisheries Abstracts*).

REVIEW AND EVALUATION

The Reserve will submit an annual report on research activities to SRD as required by National Estuarine Research Reserve System Regulations Section 921.34. The report will include a description of program successes,

accomplishments, and the work plan for the coming year. The first report will cover the 12-month period following receipt of acquisition and development funds and will be submitted within three months after the end of that period. In addition, the Reserve will arrange for the periodic NOAA evaluation visits and public meetings described in Section 921.34 of the National Estuarine Research Reserve System regulations.

RESTORATION PLAN

National Estuarine Research Reserve System regulations recognize that many estuarine areas have undergone ecological change as a result of human activities. Although restoration of degraded areas is not a primary purpose of the National Estuarine Research Reserve System, some restorative activities may be permitted in Research Reserves as specified in their management plans. Restoration for single-species resource management or enhancement is not usually permissible; restoration must be community- or ecosystem-oriented.

In accordance with National Estuarine Research Reserve System regulations, this management plan describes those portions of Reserve sites that may require habitat modification to restore or rehabilitate them back to their historic, natural conditions. The plan also provides guidelines for developing site-specific restoration plans. At this stage of program development, it is possible only to preliminarily identify which resources might be need restoration, not to describe the full extent of resource degradation, the techniques and methods that will be used in restoration, the costs of restoration, or the potential benefits or consequences of restoration efforts, including the length of time it might take for an area to become restored to proscribed conditions. Further assessment is needed of site-specific conditions, pertinent literature and other factors to determine site-specific restoration needs.

RESOURCE DEGRADATION AT THE RESERVE SITES

GOODWIN ISLANDS A portion of the upland ridge on the Goodwin Islands is overgrown by grape, greenbrier, honeysuckle and blackberry. Vines carpet the ground and shrub layers and extend well into the canopy. The thick growth is excluding other vegetation and making this portion of the island practically impenetrable.

Several stands of common reed grass, *Phragmites australis*, exist on the Goodwin Islands. Although not extensive, the growth has replaced the more desirable big cordgrass, *Spartina cynosuroides*. *Phragmites* is a tenacious species that tolerates suboptimal conditions and is hard to eradicate. The *Phragmites* colonies on the Goodwin Islands will be monitored through aerial photography and habitat plots.

CATLETT ISLANDS A small stand of *Phragmites* has been found on Thompson's Island in a section of the transition zone between the high marsh-saltbush line and the forested uplands. The other islands need to be surveyed for the occurrence of *Phragmites*.

TASKINAS CREEK Several places are eroding along Taskinas Creek Trail. The most pronounced erosion is occurring along a section of the trail that has a steep slope and is used as a bridle path. Also, on either side of the Taskinas Creek boardwalk the banks are slumping where people have wandered off the trail to get a closer look at the creek and marsh. One particular overlook exists on a steep bank (with a 50 feet sheer dropoff to the creek below) and presents a potentially dangerous situation.

Small stands of *Phragmites* have been found in remote areas of the creek drainage, on the levee between low and high marsh, where they are replacing big cordgrass.

SWEET HALL MARSH The bank and cultivated field above Sweet Hall Marsh are subject to erosion during heavy rainfall.

Phragmites is invading some sections of the levee between the low marsh zone and back

marsh. Here, *Phragmites* is replacing big cordgrass.

GUIDELINES FOR RESTORATION

In order to properly evaluate the need for restoration and plan effective and environmentally sound restoration projects, the Reserve proposes to follow the guidelines described below.

Determine the extent and severity of resource degradation

Each site will be surveyed using aerial photography interpretation and ground-truthing to determine the extent and severity of resource degradation. Much of this work will be performed during species inventory and habitat mapping projects described in the Research and Monitoring Plan. Past conditions will be assessed from discussions with longtime residents and through studies of historical photography, sediment cores, pollen diagrams, dead and dying vegetation, and old field notes and diaries. Information on present and historical conditions will be quantified.

Convene expert panel and set goals for restoration

If a problem is documented and determined to require attention, goals will be set to guide the development of the restoration plan and serve as measures of success or failure. An expert panel will be convened to examine the situation and determine whether the goal should be restoration (re-creation of entire communities of organisms, closely modeled on those existing there naturally or previously); rehabilitation (selective removal of objectionable organisms or conditions and progressive actions to restore what was previously present); replacement (replacing the original ecosystem with another different one); or status quo with monitoring (implementing a surveillance procedure to determine whether damages are progressing, retreating naturally or at equilibrium).

Synthesize existing information and evaluate results of similar projects

The scientific literature will be consulted to identify and evaluate approaches that have been used to restore or rehabilitate similar coastal habitats. Files on 404 Wetland Permits requiring mitigation also can be used to identify the types of projects that have been attempted. Results from completed projects will be evaluated to determine appropriate methods, expected results and potential problem areas to avoid.

Design and implement project

At this step it should be possible to determine the best techniques to remedy the problem. In general, the least complex, most proven methods and the most cost-effective and maintenance-free procedures will receive first consideration. Any necessary permits from regulatory authorities and permission of landowners will be obtained. A qualified investigator will implement the project.

Monitor results and evaluate success of restoration

Monitoring programs will be designed and carried out as appropriate by Reserve staff, funded investigators or contractors, or volunteer team. In general, monitoring will include aerial reconnaissance and site visits to determine maintenance needs, additional remedial action, and how well restoration efforts have achieved the desired goals. Information derived from monitoring will be disseminated through appropriate channels.

EDUCATION PLAN

FRAMEWORK

The Reserve's education program will operate, in part, through cooperative efforts with existing educational institutions and organizations in the region and will build upon environmental education materials already available for the Chesapeake Bay and for estuaries in general. Education activities will be de-

signed to enhance awareness and understanding of site resources as well as general estuarine systems. Particular emphasis will be placed on the role of the estuary in the total Chesapeake Bay environment and on the interrelationships of coastal habitats and human activities.

Taskinas Creek will be the primary focus for Reserve education efforts because of its education facilities and its central location and proximity to large population centers. The focus will be on Taskinas Creek as a living laboratory, using and supplementing existing boardwalks, trails, canoe trips, and outdoor exhibits as educational learning aids. A feasibility study will be conducted on building a research and education center with a dormitory. Where practical, education programs will be linked to research projects involving Taskinas Creek and other sites.

The Reserve's education programs will avoid placing stress on the environment, and activities will be conducted outside of the critical research core area to prevent disturbance to research or natural characteristics. Emphasis will be placed on interactive education activities, based on the premise that interest in and commitment to the Chesapeake Bay and its tributaries are greatly affected by personal contact with the natural system (Chesapeake Executive Council, 1987).

To meet the goals and objectives of the education program, the Reserve will hire an education coordinator to develop, coordinate and conduct education programs at appropriate Reserve sites. The education coordinator will work with an Education Advisory Committee to identify priority projects for funding through SRD and other sources.

The education coordinator will organize outreach activities to schools, special interest groups, civic groups, and professional organizations and will be available to help schools and other groups develop and conduct environmental projects at Reserve sites. Other duties and responsibilities of the education coordinator are described in the Administration Plan section of this management plan.

This Education Plan describes the education and interpretation programs and activities that will be encouraged under the auspices of the Reserve. These programs and activities will focus on the value of the Chesapeake Bay estuarine system, particularly the York River basin, and its wise use and management. Emphasis will be placed on disseminating information about the results and value of research conducted within the boundaries of the Reserve sites, as well as providing opportunities for hands-on participation in nature studies.

This Education Plan was developed after reviewing education plans from other Reserves, evaluating the four Reserve sites for opportunities for and constraints to on-site education programs, and a meeting of an Education Planning Committee in June 1989. The results of these efforts provided ideas for programs, activities and interpretive media that fulfill the goals and objectives of the Reserve but do not duplicate ongoing educational efforts.

OPPORTUNITIES FOR AND LIMITATIONS TO ON-SITE EDUCATION

Evaluation Procedure

Opportunities for and limitations to on-site education programs at Reserve sites were analyzed using the following criteria: (1) resource sensitivity (e.g., presence of rare, threatened or endangered organisms; relict, fragile or significant natural communities; significant archaeological or cultural resources); (2) potential conflict or interference with ongoing research or monitoring; (3) compatibility with existing traditional uses; (4) degree of existing public access; (5) accessibility; and (6) alternate nearby opportunities for on-site education and interpretation programs. The on-site education potential of each site was rated low, medium or high. For this evaluation, the Taskinas Creek site was divided into eastern and western components. The results are shown in Table 14. The following narrative is supported by the evaluation completed by the Education Planning Committee. The sites are presented in descending order of the potential for on-site education.

Table 14
EVALUATION OF ON-SITE EDUCATION OPPORTUNITIES

Site	*Accessibility*	*Present public access*	*Compatibility with traditional uses*	*Resource sensitivity*	*Potential conflict with research*	*Alternate opportunities*
Goodwin Islands	1.4	1.3	2.0	2.0	2.5	3.0
Catlett Islands	1.1	1.1	2.0	2.7	2.3	2.2
Taskinas Creek, eastern	2.8	3.0	3.0	1.9	1.0	1.0
Taskinas Creek, western	1.8	1.7	2.5	2.2	2.3	3.0
Sweet Hall Marsh	1.3	1.1	2.1	2.8	2.7	2.1

Score key: 3 = high; 2 = medium; 1 = low

On-Site Potential: Taskinas Creek

Opportunities

Taskinas Creek provides opportunities for visiting a large, natural tidal creek system. In addition to enjoying its beauty and wildlife, visitors see a classic example of a tidal creek ecosystem with distinct wetland zonation, both from the brackish marshes at the creek's mouth to freshwater marshes at its upper reaches and from the low marsh at the low-tide mark to the high marsh and forests landward. The creek system is like a miniature version of the York River system, with freshwater inflow from feeder streams, daily tidal cycles, and mixing of salt and fresh water.

Taskinas Creek divides the Reserve site into an eastern section, where facilities and programs are focused, and a western portion, where no facilities are available. The eastern portion is used by a variety of people for recreation, education and cultural enrichment and can support still more visitors without major environmental impact. The park is conveniently located for visitors from central and eastern Virginia and is near tourist attractions in the Williamsburg-Jamestown-Yorktown historic triangle, where few other opportunities for outdoor estuarine environmental education exist.

On the eastern side of Taskinas Creek, a guided canoe trip is available extending from the brackish-water zone into the freshwater zone, and a self-guided hiking trail meanders through a transition of early successional pine forest to mature hardwood forest and across a marsh on a boardwalk over the creek. The park has a visitor center with an exhibit area, audiovisual room and a classroom with educational materials and field equipment (see the Facilities Development Plan). The park also has other trails, picnic areas, restrooms, parking areas, a pond, and a boat ramp.

Constraints

There are few constraints to using the eastern section of Taskinas Creek for the on-site education focus of the Reserve. The most limiting conditions are erosion of trails and streambanks along Taskinas Creek Trail; limited canoe trip capacity; seasonal guides and schedule; and lack of full-time staff to provide year-round education activities. In addition, the audiovisual room and the classroom are too small to accommodate large groups. A discussion of the erosion problem is presented in the Restoration Plan, and recommendations for improvements and additions to staff and facilities are presented in the Administration Plan and Facilities Development Plan, respectively.

In contrast, there are several constraints to using the western portion of Taskinas Creek for on-site education. The area is remote and not regularly patrolled by park personnel. The only facility is a narrow fire trail, which

is gated and locked. The terrain is steep and rugged with moderately to highly erodible soils. The area is heavily wooded with mixed pine and oak stands. The only vantage point overlooking the creek is on the top of a very steep, highly erodible bank. This pristine area contains some rare plant species, is ecologically sensitive, and is being used for natural history studies that could be disturbed by public access. Very limited access for nature study is recommended for this area.

On-Site Potential: Goodwin Islands

Opportunities

The Goodwin Islands provide an opportunity for studying an environment typical of polyhaline conditions of Chesapeake Bay tributaries. The site contains extensive saltmarshes and seagrass beds, wetland forests, a maritime forest, a sandy beach shoreline, and low dunes. It is the only accessible site where problems of shoreline erosion, *Phragmites* invasion, and estuarine debris accumulation can readily be observed.

Constraints

The Goodwin Islands may be reached only by boat. There are no piers, and visitors must leave vessels moored and wade ashore. The site contains many sensitive resources, such as nesting colonial birds, Ospreys and turtles, which are easily disturbed by human contact. In addition, there are permanent study areas that must remain undisturbed. On-site education programs will have to be carefully designed and controlled to minimize impacts.

On-Site Potential: Sweet Hall Marsh

Opportunities

Sweet Hall Marsh is located on the Pamunkey River, one of the most pristine rivers on the East Coast. The marsh is an excellent example of an emergent freshwater marsh, located in a section of the river where transitions from oligohaline to freshwater conditions and from freshwater marsh to hardwood swamp are pronounced. This stretch of the Pamunkey River is a major spawning area for striped bass and other anadromous fishes, supports large numbers of wintering waterfowl, and is home to the Pamunkey Indian tribe. Most of the features of Sweet Hall Marsh are best observed from a boat to prevent damage to the marsh.

Constraints

Sweet Hall Marsh is accessible only by boat, and there are no piers or facilities to accommodate visitors. The marsh is extremely sensitive to disturbance by human contact, especially by marsh walking and plant collection. It contains rare and endangered plant species and is a major wintering area for waterfowl, which also are sensitive to disturbance. To preserve the delicate balance of nature and traditional uses of the marsh, and to protect ongoing research from disruption, on-site educational use of Sweet Hall Marsh will be limited to academic pursuits (class field trips, teacher training and guided research) and occasional float-by boat trips. Much of the educational focus for Sweet Hall will occur off site or as part of float-by field trips.

On-Site Potential: Catlett Islands

Opportunities

The Catlett Islands are the last remnants of a Pleistocene beach ridge system that once characterized the north shore of the lower York River. Other ridges have eroded away or have been stabilized for development. The Catlett Island ridges support maritime forests and are surrounded by extensive mesohaline marshes.

Constraints

Constraints to using the Catlett Islands for on-site education relate to the sensitivity of the pristine forested ridges, their inaccessibility, and the incompatibility of public visitation with research and traditional uses. The islands support a heron rookery, Osprey nests, migratory waterfowl wintering areas, and other wildlife areas that are sensitive to human disturbance.

There is little evidence of human presence on the islands, yet more would be expected with increased visitation. Whether by land or

water, access to the Catlett Islands is difficult and sometimes impossible. By land, there is limited entry through private property (Timberneck Farm), but there is no appropriate parking. To reach the islands, one must walk through cultivated fields and dense forest with no trails but abounding with poison ivy, deerflies and ticks. By water, entry and exit depend on tidal stage. At low tide, the water is too shallow to reach or leave the islands. Visitors must arrive on a rising tide, leave boats at mooring, wade ashore and monitor the boats so they will not become stranded by low tide. For these reasons, public education will not be encouraged at the Catlett Islands.

ON-SITE EDUCATION PROGRAMS

The following recommendations for on-site education programs at Reserve sites are based on an analysis of current education programs and projects involving Reserve sites and the projected needs for new ones, as well as on the opportunities and constraints described above.

Current Programs: Taskinas Creek

In 1989, 72,587 people visited York River State Park. Many of those visitors participated in scheduled education programs; others pursued self-directed activities. Described below are some of the present educational opportunities involving Taskinas Creek.

Interpretive Trail

York River State Park has an extensive system of trails that guide visitors through the natural succession of coastal habitats from open and forested uplands to forested swamp, freshwater marsh, brackish marsh, creek mouth, tidal river, and river shoreline (see Figure 20). The trails support multiple uses, including hiking, biking, fitness, cross-country and horseback riding. Guided hiking trips are sometimes conducted. One trail, Taskinas Creek Trail, is self-guiding, using numbered markers keyed to information in a brochure. This trail offers year-round opportunities for enjoying and learning about the transitional zone of the York River.

Canoe Trips

Two-hour guided canoe trips on Taskinas Creek are conducted on weekends and occasionally on weekday evenings from April through October. The popular trips are educational and have a variety of themes. Guided by an interpreter, the trips improve visitors' understanding of the dynamics and ecology of the estuary and coastal communities and of those areas' environmental and socioeconomic importance. Participants learn about the development and formation of marshes; estuarine water properties; the value of wetlands to erosion control, flood inhibition, water purification, and food production; the rhythms and cycles of life in the estuary; wildlife habitat requirements and feeding relationships of estuarine-dependent species; and human uses of the marsh and river in modern, historic and prehistoric times.

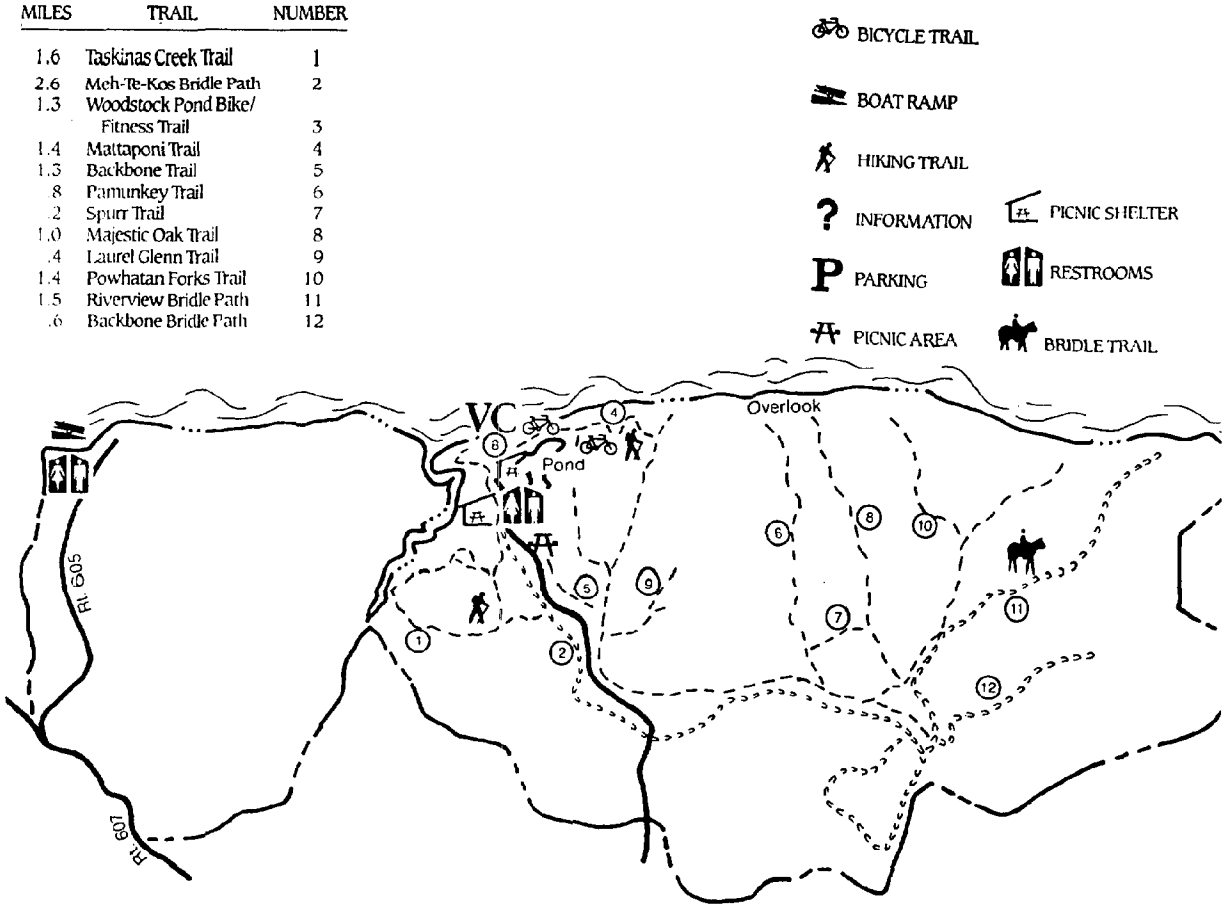
In addition to regularly scheduled public canoe trips, school classes frequently schedule one- to two-hour weekday trips as part of their educational visits to York River State Park. Such trips are conducted almost daily from mid-April through May, and periodically in September and October. The canoe trips are one of the most popular environmental education activities with school groups.

Field Trips

York County and Williamsburg-James City County Public Schools are the main users of York River State Park's environmental education offerings. Students participate in field trips conducted by their teachers or the park's seasonal interpreter. Fifth- through eighth-graders are the more frequent field trip participants, although some high school science classes conduct field trips or studies at the park. The Virginia Wildflower Society, Williamsburg Bird Club and Estuaries Day volunteers also conduct field trips.

Figure 20
TRAILS AT YORK RIVER STATE PARK

MILES	TRAIL	NUMBER
1.6	Taskinas Creek Trail	1
2.6	Meh-Te-Kos Bridle Path	2
1.3	Woodstock Pond Bike/ Fitness Trail	3
1.4	Mattaponi Trail	4
1.3	Backbone Trail	5
.8	Pamunkey Trail	6
.2	Spurr Trail	7
1.0	Majestic Oak Trail	8
.4	Laurel Glenn Trail	9
1.4	Powhatan Forks Trail	10
1.5	Riverview Bridle Path	11
.6	Backbone Bridle Path	12



Scheduled Presentations

Special presentations on a variety of environmental topics are given by park interpreters and guest speakers from April through October and by volunteers from November through March. Many of the topics are relevant to Taskinas Creek (e.g., signs of spring, wildlife observations, fossil hunts, endangered species, weather prediction). Scheduling is based on staff availability, demand and space accommodations. During the peak season from May through September, presentations are given once a week, usually on weekends.

Special Educational Programs

Trained park personnel and other educators conduct special educational programs for children during summer. These include *Story Times* (ages 3-6), *Nature Explorers* (ages 7-11), *Junior Rangers* (ages 8-12) and a 4-H marine day camp for teenagers. The programs include a beach excursion, beaver hunt hike, wildflower walk, nature photo safari, movie of the month, and cast-netting and seining off the York River beach and in Taskinas Creek.

Special Events

Estuaries Day is an example of a special event that involves Taskinas Creek and occurs at the park. On Estuaries Day, staff of the park and VIMS, along with volunteers, offer a variety of programs and activities, including guided canoe trips, bird walks, wildflower walks, seining, aquarium setup, water quality sample collection, video productions, slide shows, fish printing, plastic pollution art, and coloring contest.

Student Projects

Students from The College of William and Mary, VIMS and other schools conduct independent research projects involving Taskinas Creek for thesis, dissertation and honors credit.

Current Programs: Goodwin Islands

The present annual educational use of the Goodwin Islands includes 10 field trips, one undergraduate-level student project, one graduate-level student project and one Boy Scout project. In 1989, 58 people visited the Goodwin Islands to participate in VIMS-sponsored research and education programs. The following opportunities are available:

Field Trips

Professors from The College of William and Mary and its School of Marine Science lead field trips to the Goodwin Islands for students of geology, biology and marine science. Occasionally, the Virginia Living Museum leads field trips for students in grades 9-12 and for adults. The focus of the trips is the ecology and geology of beaches, seagrass and saltmarsh habitats, and forested uplands. Field trip leaders emphasize the physical conditions of each habitat, vegetation zonation, identification of selected flora and fauna, human impacts, and importance of the Goodwin Islands habitats to the overall Chesapeake Bay system.

Student and Civic Projects

Approved graduate and undergraduate research projects are conducted at the Goodwin Islands. For example, geology majors from William and Mary have undertaken research on sediment transport, coastal morphology, mineralogy and stratigraphy, and the coastal botany class at VIMS participates in long-term marsh studies. Projects for Eagle Scouts and civic and environmental organizations are possible (e.g., a beach clean-up was organized by an Eagle Scout with the Gloucester Point Boy Scout Troop).

Current Programs: Sweet Hall Marsh

The present annual educational use of Sweet Hall Marsh includes two field trips, four float-by boat trips, two canoe trips, one undergraduate research project, and five graduate research projects. In 1989, 56 people visited Sweet Hall Marsh while participating in educational float-by boat trips and class field trips. Students, faculty and staff of VIMS visited Sweet Hall Marsh 66 times that year. A description of those activities follows.

Float-By Boat Trips

VIMS, the Council on the Environment, the Chesapeake Bay Foundation, The Nature Conservancy and the Virginia Living Museum conduct interpretive boat trips on the Pamunkey River near Sweet Hall Marsh. Participants learn about the ecology of the area, management issues and ongoing research. These popular boat trips provide an excellent opportunity for experiencing and learning about the tidal freshwater ecosystem.

Field Trips

Coastal botany and marine resource management classes from VIMS take field trips to Sweet Hall Marsh. Several of the field trips involve long-term research projects.

Academic Research Projects

Graduate and undergraduate students from the College and VIMS conduct independent research projects for thesis, dissertation, and honors credit.

Current Programs: Catlett Islands

The Catlett Islands are the most remote Reserve site. The present annual educational use of the Catlett Islands includes one high school student project and one graduate student project. In 1989, the Catlett Islands were visited by 29 scientists, three student visitors and three educators. The Catlett Islands were used for wetland delineation training and independent student projects for students affiliated with VIMS.

EXPANSION OF EDUCATION PROGRAMS

Taskinas Creek

York River State Park will be encouraged to continue, expand and offer more frequently interpretive field trips and canoe trips. Under the auspices of the Reserve, it is possible that a research and education center will be built in the park to accommodate visiting groups. Possible features include dormitory space, a kitchen, classroom, reference library, office space and sample-preparation areas. It is recommended that the audiovisual room in the visitor center be enlarged to accommodate larger audiences (see the Facilities Development Plan). To effectively achieve the education objectives of this plan, VIMS proposes to employ a full-time education coordinator for the Reserve. The education coordinator will be headquartered at VIMS but will spend part of the work week at the park when office space is available.

Teacher Training

York River State Park is an ideal location for teachers to meet and receive training for leading students in environmental studies. The proposed research and education center will be designed to accommodate the training sessions. The Reserve will sponsor workshops to familiarize teachers with the ecology of Taskinas Creek and train them to lead their students in hikes or in activities like seining, taking water samples or conducting marsh and forest investigations. This will enable teachers to involve students in collecting data valuable to the Reserve's research program and, in turn, will benefit students. By learning how to report and analyze data collected on field trips and by knowing that the data are important to science and often have practical uses, students will gain pride in their work and realize that they are helping solve real problems. There are few other opportunities for this type of teacher-student participation in research.

The Virginia Department of Game and Inland Fisheries will be encouraged to conduct teacher workshops at Taskinas Creek under Project Wild and Aquatic Project Wild. Teacher workshops will be encouraged offering first-hand experience using lesson plans from the recent U.S. Fish and Wildlife Service publication *Bay BCs* and activities from *River Times*, a set of science and social studies activities developed by the Math and Science Center in Richmond.

On-site summer courses for teachers for academic credit, credit toward five-year recertification, or salary also will be offered at the proposed Research and Education Center. Teachers participating in summer courses

will be lodged at William and Mary until the proposed dormitory is constructed. Programs will be developed to give them on-site experience at Taskinas Creek as well as the Goodwin Islands.

In addition to courses, the Reserve will promote teacher-researcher mentorships involving Taskinas Creek and the other Reserve sites. The Center for Gifted Education at William and Mary offers a 30-hour mini-mentorship for elementary and middle-school science teachers of gifted students to give the teachers more realistic insight into the work of scientists. VIMS assists in this program by recruiting scientists who are willing to work with teachers and use them in sampling, monitoring and other research activities. This involvement will be expanded to involve scientists who are conducting research at Reserve sites. In addition, opportunities for mentorships will be extended to other science teachers.

Seminars and Hands-On Field Trips for Decisionmakers

The Reserve will coordinate and cooperate with the Council on the Environment and Alliance for the Chesapeake Bay in providing Reserve sites for seminars and field trips for local decisionmakers. VIMS, in cooperation with state and private entities, is developing a training program in wetlands delineation and will use the Reserve for training and testing.

Training for Volunteers

Training sessions for volunteers will be conducted to enhance the quality of volunteer activities at Taskinas Creek and the other Reserve sites. Research scientists, park interpreters or Reserve staff will train volunteers. Volunteer activities are described in the Volunteer Plan.

Curriculum Development

To develop curricula containing activities appropriate for use by classes coming to Taskinas Creek, the Reserve will work in cooperation with other organizations having similar education goals and objectives (e.g., Chesapeake Bay Foundation, Virginia Marine Science Museum, VIMS Marine Advisory Service, Virginia Living Museum, The Mariners' Museum, Council on the Environment). The Reserve is already assisting in the development of activity plans for use at Virginia's coastal state parks. Packets of information will be developed to assist teachers in preparing their classes for visits to the Reserve, in leading on-site activities, and in follow-up activities.

Programs for Overnight Groups

Evening programs for residents at the proposed Research and Education Center will be developed. Evening programs will include night-time outings in the Reserve, audiovisual presentations and a lecture series.

Goodwin Islands

At present, the annual educational use of the Goodwin Islands is adequate to meet the educational objectives of the Reserve. On-site educational use of Goodwin Islands will not be increased unless a carrying capacity study shows that the islands can accommodate additional visitation without concomitant environmental damage.

Sweet Hall Marsh

At present, the annual educational use of Sweet Hall Marsh is adequate to meet the educational objectives of the Reserve. Given the sensitivities of the area, on-site educational use of Sweet Hall Marsh will not be expanded.

Catlett Islands

At present, the annual educational use of the Catlett Islands could be increased to accommodate as many as two additional student projects without threatening the resource, ongoing research or traditional uses. On-site educational use of the Catlett Islands will not be expanded beyond that level unless a carrying capacity study shows that the islands can accommodate additional visitation without concomitant environmental damage.

ON-SITE INTERPRETIVE MEDIA

Current Media: Taskinas Creek

Exhibits

Exhibits on estuarine themes are displayed in the lobby of the park's visitor center and at overlooks to Taskinas Creek and the York River. In addition, bulletin boards outside of the visitor center and at Croaker Landing display information on scheduled programs.

Publications

Several publications are available at the park, including a brochure for the self-guided tour of Taskinas Creek Trail; a park brochure; a booklet about Virginia State Parks; and a newsletter announcing current and upcoming interpretive programs. The park also has field guides and reference materials in a cataloged library, which can be used by teachers, students and the public.

Environmental Education Materials

Park holdings include environmental education materials, such as the VIMS *Marine Schoolhouse* series, VIMS *Marine Science Methods for the Classroom* series, and the University of California's *Outdoor Biology Instructional Strategies*. These materials cover topics in geology, ecology, wildlife biology and pollution. The park also provides teaching aids and field equipment that can be used by visiting school groups or educational program participants, including a herbarium, saltwater and freshwater aquaria, microscope, wildlife specimens, and reference books (see Table 15).

Audiovisual Media

York River State Park has two slide shows, *York River State Park* and *Virginia's Marshes*, and one video program, *York River: The Peninsula's State Park*. The park has access to several other slide shows and videotapes.

Current Media: Goodwin Islands, Catlett Islands and Sweet Hall Marsh

There are no interpretive materials for Goodwin Islands, Catlett Islands or Sweet Hall Marsh.

EXPANSION OF INTERPRETIVE MEDIA

Taskinas Creek

Exhibits

The educational value of the boardwalk crossing Taskinas Creek will be improved by adding an exhibit illustrating and describing marsh zonation, marsh plants and animals, estuarine fishes and shellfish, and other aspects of the estuary. The Taskinas Creek overlook exhibit will be replaced with a new one commemorating the designation of the Reserve. New exhibits are needed within the visitor center to communicate information about the Reserve, the other Reserve sites and ongoing research and monitoring at Reserve sites. These exhibits could include photographs of flora, fauna and general ecology of each site, as well as an aquarium or terrarium containing living microcosms from the sites.

Publications

Several publications are proposed. The Reserve will provide an insert with a map and information about the designated sites for the National Estuarine Research Reserve System brochure. A brochure or prospectus giving information about opportunities for research, environmental education, teacher training and mentorship programs, and volunteer programs will be developed. The Reserve also will develop a guidebook for landowners who are interested in donating land or conservation easements to the program. The park will be encouraged to develop a guidebook for canoe trips on Taskinas Creek. The Reserve also may produce a series of field guides on the natural and historic resources of the York River watershed, using the Reserve sites as reference points. The presence of the National Estuarine Research Reserve Association logo will make all Reserve publications recognizable as such.

Environmental Education Materials

School information packages (described as part of Curriculum Development) will be available through the Reserve and York River

Table 15
INVENTORY OF ENVIRONMENTAL EDUCATION EQUIPMENT AT YORK RIVER STATE PARK

Biology and Ecology
Waterscopes
Seines (3)
Tide stakes
Insect jars
Water thermometer
Dipnets
Buckets (6)
Minnow trap
Water chemical test kit (Hach)
White enamel pans
Bottom sampler
Depth measure/sounding line
Plankton nets
Casting nets (3)

Wet Laboratory
Permanent Equipment
Herbarium
Microscopes
Wildlife specimens
Wildlife movies
Saltwater aquarium
Freshwater aquarium
Touch table items
Wall displays
Reference book shelf
York River State Park movie

Wildlife Identification
Animal cast tracks
Plaster of paris
Wildlife check-off list
Estuary guides
Pond guides
Reference books

Bird Study
Bird guide
Telescope for hikes
Wildlife specimens
Check-off list
Bird blind

Audiovisual
Kodak Audio viewer
Audiotronics cassette recorder
Extension tubes (3)
Bogen Amp
Audio equipment animation box
Electro-voice microphone
Wire junction box
Kodak movie projector
Cousino message repeater
Slide projectors (5)
Bogen speakers
AVL Dissolve Module Mark II (2)
Microphone stand
Screen

Mathematical Equipment
Mapping tools
Compass

State Park. In addition, a fact sheet will be prepared providing ideas for school science fair projects. Recommendations will emphasize non-manipulative estuarine and wetlands science projects and will be directed toward plants and invertebrates rather than vertebrates. The Reserve also will prepare a teacher's handbook for use in pre-trip training for field trips and float-by boat trips, as well as for use with students before, during and following the field or boat trips. The handbook will include suggestions for research projects associated with field trips. Materials will be prepared appropriate for 7th- through 12th-grade students and their teachers and for college classes.

Audiovisual Media

A revised version of the Reserve slide show will be produced using new aerial and ground photography, professional narration, background music and automation. The slide show will be shown at the visitor center, alternating with park slide shows, and will be available for presentations at off-site locations.

A professional video documentary on the ecology of the York River basin and the Reserve sites will be produced and shown in the visitor center. It will be promoted for use by television stations, schools, public libraries and museums.

Promotional Materials

Promotional materials include press releases for special events, souvenir T-shirts for Estuaries Day, and posters announcing special events or illustrating various aspects of Reserve ecology. Promotional materials will be exhibited at the park visitor center, VIMS Aquarium and other appropriate places.

Newsletter

A newsletter will be created to publicize educational programs, special events, and items of interest concerning Reserve sites; announce opportunities for volunteer services; commemorate noteworthy volunteer work; and give updates on research in the system and on issues affecting the health of Reserve sites and York River basin ecosystems.

Signs

The name of the Taskinas Creek National Estuarine Research Reserve will be added to the York River State Park entrance sign. The Park is encouraged to erect a larger directional sign to York River State Park on Lightfoot Road. Additional small wooden signs could be installed along Taskinas Creek trail to improve the educational value and enjoyment of the trail.

Reference Library

A reference library of materials concerning the Reserve sites in particular and the Chesapeake Bay and estuaries in general will be housed in the proposed research and education center. A personal computer will be installed in the reference library to give access to the Chesapeake Bay Bibliography at VIMS. The reference library will be available by reservation for use by the general public, teachers and students.

Bookstore

It may be possible to incorporate a small bookstore in the visitor center to sell nature books; field guides; and ecology and conservation coloring and activity books for children. The bookstore could be operated as a subsidiary of the William and Mary Bookstore, and the cashier could be the park receptionist or a Reserve volunteer.

Goodwin Islands, Catlett Islands and Sweet Hall Marsh

The only on-site interpretive materials planned for the Goodwin Islands, Catlett Islands and Sweet Hall Marsh are signs stating the name of the Reserve and designated lead agency and, where appropriate, signs posting against hunting, trespassing or boat wake.

OFF-SITE PROGRAMS AND MEDIA

Mobile Exhibits

Mobile exhibits and displays of educational and interpretative value will be designed for use at VIMS, in shopping malls, at the annual state fair in Richmond, and at other off-site locations. The exhibits will include professional-quality photographs of scenery, flora and fauna from Reserve sites.

Presentations

Reserve staff, research scientists, and trained or professional volunteer speakers (as members of a speakers' bureau) will be available to make audiovisual presentations. These presentations will cover activities at Reserve sites, as well as a wide range of environmental topics. Suggested topics include conservation of natural resources of the York River basin and the Chesapeake Bay watershed; ecological value of the ecosystems represented by the four York River sites; and the results of ongoing research. Targets for presentations include schools and civic groups, as well as conferences, such as those of the Virginia Association of Science Teachers, Virginia Education Association, Department of Education, Mid-Atlantic Marine Education Association, Virginia Junior Academy of Science, and Virginia Association of Environmental Educators.

Outreach to Schools

An outreach program to encourage the use of Taskinas Creek and other appropriate Reserve sites will be developed. It may be possible to provide Reserve staff or contract teachers to local schools to make classroom presentations, including student hands-on participation. A program offered less frequently than the VIMS Bay Team program of daily presentations throughout Virginia may adequately serve the needs of the Reserve.

VOLUNTEER PLAN

Volunteers will be an integral part of the Reserve program. Because funds for education and research are never quite adequate, the use of volunteers will expand the Reserve staff without large expenditure of funds. A volunteer program also can be one of the best means of informing the public about the value of estuaries. Properly trained, vol-

unteers carry their knowledge and enthusiasm to a portion of the general population that is larger than the scientist or environmentalist can reach.

ORGANIZATION

Volunteers will be divided into teams in three divisions, education, research and administration, with a coordinator for each. Each coordinator will be responsible for the teams in his or her division and for coordinating efforts among the divisions. At the team level, one volunteer will be team leader, reporting to his or her coordinator. Team members will work independently, in pairs or in groups. Some teams will function on a schedule (e.g., weekly or monthly), whereas others will be on call and used when a need arises requiring their particular expertise. Recruitment of volunteers will be site-specific. For example, volunteers in the Sweet Hall area will not be asked to extend their service to the Goodwin Island site.

By necessity, the Reserve will begin with a small group of volunteers, which will provide a positive initial experience for volunteers and staff. An application and screening process will be designed to ensure that volunteers are placed where they can enjoy their service and be most productive. The Reserve and the supervising scientist or educator will approve volunteer projects.

To attract potential volunteers, the Reserve will rely on word-of-mouth, press coverage and information posted at state parks, nature centers, nature trails, schools, and county administration offices. Members of organizations (e.g., Boy Scouts, Girl Scouts, Audubon Society, The Nature Conservancy, Jaycees, Women's Clubs, and retiree groups) will be solicited through mailings and presentations about the sites and the potential for volunteer service. The Reserve staff also will contact particular individuals, such as affected landowners and neighbors of the four sites, to invite them to become volunteers.

To be successful, volunteers must be well trained. All participants will learn about the basics of estuaries, the Chesapeake Bay and the York River estuaries in particular. Each team's training will then depend on the skills specific to that team's job. Teams that work in the field will have on-site training to ensure that they have mastered all skills. A test of information and skills will be given before the volunteers begin their tasks.

Coordinators will communicate with team leaders and members to ensure the quality of the team's work and reduce the chance of frustration on the part of the participants. Team members will have access to the coordinator and the scientist in charge of the research, thus allowing discussion of questions, concerns and triumphs.

Team assignments will be for a specific task over a stated time period. A need for volunteers will be identified and team tasks will be clearly defined before a team is formed. On-call teams will be organized when general needs are defined but not set into action until a specific project is approved. At the end of the assignment, an evaluation will be done. The evaluation will review the effectiveness of the task, the quality of the work performed, and the support that the volunteer received. On the basis of this evaluation, the Reserve will adjust the volunteer program. Team members will be given an opportunity at this time to change teams, and the coordinators will have an opportunity to reward, reassign or fire individuals.

Several reward schemes are being considered. The Division of State Parks has a point-award system that the Reserve can use or modify. Expansion of the awards scheme for completion of tasks, hours served, and exceptional performance will be necessary, because not all volunteers will be interested in park-oriented rewards. Components of this expansion are: events or appropriate gifts (e.g., Reserve T-shirts or posters); an annual gathering to recognize outstanding teams and individuals, thank all participants, and share experiences and information; advancement and added responsibility in the program for outstanding individuals; and job descriptions suitable for resumes or publications.

To realize the positive impacts of a volunteer corps, the Reserve will adopt and modify volunteer information and application mate-

rials developed by Padilla Bay National Estuarine Research Reserve. These guidelines for volunteers address the expectations of the volunteer and Reserve staff and provide a vehicle for a volunteer's talents to be discovered and best used. Volunteer applications will be available at Reserve headquarters, York River State Park and other appropriate places.

SCOPE

Opportunities for and limitations to volunteer activities are similar to those listed for on-site education in the Education Plan. They are discussed below by site in descending order of opportunities.

TASKINAS CREEK Volunteer teams of all three types (research, education and administration) are already needed at York River State Park, where understaffing is a problem. In winter, when the paid staff is decreased, volunteers can help by freeing staff from office jobs and by providing manpower to extend the season that the visitor center is open. The park superintendent will approve all Reserve volunteers and projects involving the park. The park's location will provide a large pool of potential volunteers. While accessibility to the park is not a problem, access to some of the research sites will involve marshwalking and trail hiking.

GOODWIN ISLANDS Opportunities for volunteer activities on the Goodwin Islands are limited, although research and educational activities planned for this site can use volunteers. On-site volunteer activities in the research field will include sampling, recording data or otherwise assisting in or conducting a research project. Education teams can be involved in field trips and litter patrol. The Goodwin Islands can only be reached by boat, which limits on-site volunteer activity, and the present use of the Goodwin Islands by undergraduates and graduates does not lend itself to volunteer participation.

SWEET HALL MARSH Opportunities for volunteer activity at Sweet Hall Marsh lie in the realm of quality time rather than quantity time. Because Sweet Hall Marsh is in an area of low population density, recruitment of a large number of volunteers will be difficult. However, because public access to the site will be limited, fewer volunteers will be needed. To preserve the site's natural state, on-site educational is limited to occasional float-by boat or canoe tips. Volunteer guides will serve as interpreters and will need boating and canoeing expertise. Some field research projects may be able to use volunteers, although walking on the bottomless substrate of a freshwater marsh to reach a research site will weed out all but the most dedicated and agile volunteers. Seasonal constraints also will limit volunteer activities as research and education activities are reduced or eliminated before and during duck season.

CATLETT ISLANDS As for Sweet Hall Marsh, restrictions on public access and the location of the Catlett Islands will limit the number of volunteers and the number of volunteer hours. Research teams will be limited by the types of projects that can use volunteers and by the difficulty of getting to the site. In general, there are opportunities for volunteers to be involved in sampling, recording data or other research activities. Opportunities for education teams are limited to off-site speakers who make presentations about the research projects underway on the Catlett Islands.

VOLUNTEER TEAMS

General Education Teams

OUTREACH TEAMS will carry the Reserve's message to the surrounding communities. A volunteer on an outreach team will serve either on a speakers' bureau or a liaison team. The latter will provide a liaison with civic groups, clubs, and local and state governing bodies. The speakers' bureau will provide volunteers for groups requesting programs about the Reserve program or sites.

EXHIBITS TEAMS will plan, implement, maintain and update multimedia displays and signs for on- and off-site use. Exhibit teams will include volunteers who are capable of producing the artwork and photography

needed for effective stationary and mobile exhibits, as well as wooden cases for displaying exhibits. Groups will adopt an exhibit and ensure that it is clean and up to date.

A PUBLICATIONS TEAM will help design, produce, and deliver newsletters, brochures and other publications. Several projects are available for a publications team: a program brochure; a prospectus for each Reserve site; a brochure for a self-directed horse trail within York River State Park; and a brochure for the Taskinas Creek canoe trail.

A WRITERS TEAM will help the staff or other volunteer teams with projects, as well as produce articles, curriculum and guidebooks.

SPECIAL EVENTS TEAM members help at special events sponsored by the Reserve or York River State Park. For example, the Reserve and the park co-sponsor Estuaries Day and need volunteers to help stage events. Other special events at Taskinas Creek and Goodwin Islands will include a school for field studies, EarthWatch, Youth Conservation Corps projects, estuarine debris cleanups, and water camps for volunteers.

A ROVING TEACHERS TEAM will provide a corps of informed, trained teachers to visit classrooms with programs on estuaries and the Research Reserve program.

Site-Specific Education Teams

CANOE TRIP GUIDES will be convened for the Goodwin Islands, Taskinas Creek and Sweet Hall Marsh. Members will be available to lead specific groups to observe activities at the research sites.

TRAIL GUIDES will be used at Taskinas Creek to lead groups visiting the sites.

CONSTRUCTION TEAMS will be used at Taskinas Creek to build trails and displays or to help with building projects needed at the sites. Team members will be recruited for any restoration projects approved by the Reserve.

TRAIL REPAIR TEAMS will be responsible for maintaining the trails and signs at Taskinas Creek. Teams will adopt specific trails and maintain and improve them under the supervision of the superintendent.

Research Teams

The research teams will be effective only if the volunteers and the scientists see the work as meaningful. Scientists must participate in the planning for the use of volunteers on their projects, especially in the areas of job descriptions, training, supervision and quality control. Teams will not be formed until a project involving volunteers is approved by the Reserve and the supervising scientist. Training will include on-site instruction to ensure that the data collected are of value. Quality control checks will be done during the project to reassure the scientist that the data are accurate. To assure the volunteer that his or her work will be used, the progress and results of the project will be communicated to the participating teams.

Based on proposed or ongoing research projects at the sites, the following research teams are proposed:

A BIRD CENSUS TEAM has begun in a small way with a volunteer, Teta Kain, doing a monthly bird census on the Catlett Islands. Other teams will be formed to carry out similar studies at other sites. Training in field identification and bird song recognition will be a drawing card for this team.

VEGETATION SURVEY TEAMS, consisting of trained plant identifiers and data recorders (identifiers-in-training), will identify plants and estimate percentage cover in the field.

SAMPLER TEAMS will collect data on such parameters as tides, water quality and weather conditions. Water quality monitors have been recruited and are being trained for all four sites.

ANGLERS SURVEY TEAMS will use volunteer anglers to record their catches in personal fishing diaries.

RIVER WATCHER TEAMS will monitor areas of the river for pollution, boating, fishing and land use.

WILDLIFE CENSUS TEAMS will use the Department of Game and Inland Fisheries' Wildlife Observation Forms, as appropriate, to record observations of wildlife in the Reserve areas.

SEASONAL WATCH TEAMS will collect data on migrating or spawning organisms.

DATA ENTRY TEAMS will enter data, analyze data, design data systems, or serve as advisers to Reserve staff, depending on the member's level of expertise.

HISTORICAL RESEARCH TEAMS will gather information from genealogical studies and area residents on an area's natural and social history.

CLASSROOM TEAMS, each consisting of a teacher and his or her class, will undertake projects associated with specific research goals.

Administration Teams

Guidelines for administration teams must be developed as the program and its needs develop. Two administrative teams have been identified:

An OFFICE STAFF TEAM will be organized to perform standard office functions, as well as to serve as receptionist at the visitor center, salespersons in the bookstore, and clerks in the reference library. The need already exists for administrative teams at Taskinas Creek.

DONOR TEAMS will comprise people who allow access to their land or who donate things rather than time or service. Such a team will provide a way to recognize the contributions of these people and acquaint them with other volunteers.

In addition to volunteer teams, the Reserve will investigate the possibility of establishing a FRIENDS OF THE RESERVE foundation or association to assist in fundraising, establishing conservation easements, starting local land trusts, and providing scholarships for Reserve-related research and education projects.

FACILITIES DEVELOPMENT PLAN

Funding is provided by NOAA and matched by the state for the construction or renovation of visitor centers, research facilities, education centers and other improvements associated with research, education and access to Reserve sites. Facilities and improvements must be located within the boundaries of the designated Research Reserve.

Major construction projects (i.e., buildings) require the preparation of architectural and engineering plans and state approval of capital outlay proposals. Funding for planning and developing architectural and engineering plans for buildings comes from initial acquisition and development grants, which can be awarded after the approval of the draft management plan (i.e., in the predesignation phase), as well as later acquisition and development awards. Funds for constructing buildings come from acquisition and development grants awarded after approval of the final management plan.

Minor construction and acquisition activities that aid in implementing portions of the management plan (such as nature trails, boardwalks, boats and boat ramps) do not require architectural or engineering plans. Funding for planning and constructing nature trails, boardwalks, boat ramps, and other minor improvements can be awarded under initial acquisition and developent grants, as well as under later acquisition and development grants.

The number and types of facilities and improvements needed by the Reserve vary with the intended use of each site. The Reserve has performed a preliminary assessment of facility and improvement needs in consultation with advisory committees, members of the scientific and education communities, and affected landowners. The results of that assessment are presented herein.

EXISTING FACILITIES

A brief description of existing facilities and equipment at the Reserve headquarters at VIMS and at individual sites is presented below, followed by a list of improvements or additions needed for existing facilities.

RESERVE HEADQUARTERS In 1990 the Reserve staff moved into Brown House, a new acquisition on the VIMS campus at Gloucester Point. Brown House was acquired using funds provided by the Virginia General Assembly. General funds also provide the primary administrative support for the Reserve, including staff salaries, travel and equipment, as well as maintenance and upkeep of Brown House. Additional support is provided by SRD and private funds. Floor plans for the Brown House are shown in Figures 21 and 22.

Located on the York River, VIMS is ideally suited for Reserve headquarters. VIMS supports research scientists and teaching faculty in biological, physical and chemical marine science disciplines. The campus contains teaching and research laboratories, classrooms, offices, auditorium, conference rooms, visitor center with seawater aquaria and children's touch tank, extensive flowing seawater systems, holding tanks, hatcheries, and a library with 800 periodical subscriptions, 37,033 bound volumes, and 2,550 maps, charts, and other items. Research and teaching activities are well supported by sophisticated analytical instrumentation, state-of-the-art field sampling equipment, a computer center with an extensive network of on-line terminals and microcomputers, remote sensing and GIS laboratory, herbarium and fisheries collections, a physical plant with maintenance and construction capabilities, and a boat basin and research fleet of 20 trailerable boats and six vessels in the 40-foot class. VIMS owns a deHavilland Beaver, which is used for aerial photography, radio-tracking and travel to remote places.

VIMS has a long history of research and educational involvement in marine science. As stated in the Code of Virginia, VIMS is responsible for conducting basic scientific and applied research and providing timely and accurate information to the governor and citizens of the Commonwealth regarding the quality and conservation of marine resources, both living and non-living. In addition, as the School of Marine Science of The College of William and Mary, VIMS offers graduate marine educational opportunities at the master's and doctoral levels, as well as, on occasion, opportunities for undergraduates, high school students in the Governor's School for Science and Technology, and teachers. VIMS also provides marine advisory services to watermen, recreational fishermen and marine science educators. VIMS is located only a short distance from the Goodwin Islands and Catlett Islands and a moderate distance from Taskinas Creek and Sweet Hall Marsh. Distances and travel times to Reserve sites by land and water are presented in Table 16.

GOODWIN ISLANDS There are no facilities on the Goodwin Islands, and no facilities are proposed for the site. To protect the ecological integrity of the islands, no improvements for access are recommended. Reserve identification signs and posted signs are the only improvements foreseen.

CATLETT ISLANDS There are a few structures on the Catlett Islands (a small hunting lodge with pier and a few duck blinds). The hunting lodge, pier and duck blinds are maintained by Mr. Homer Buck of Hayes. A footpath has been established on Thompson Island to facilitate a monthly bird census, student projects, and visits by special guests. Some improvements to this trail may be needed to prevent damage to the wetlands. No other trails or facility improvements are planned. The Catlett Islands are located close enough to VIMS that the Reserve headquarters will serve as a staging area for research field trips.

TASKINAS CREEK This site will be used for research and environmental education. As proposed in the Public Access Plan, to accommodate visitor use, facilities and public access will be focused on eastern Taskinas Creek, where facilities, trails and parking ex-

Figure 21
FIRST-FLOOR OFFICES IN BROWN HOUSE, VIMS

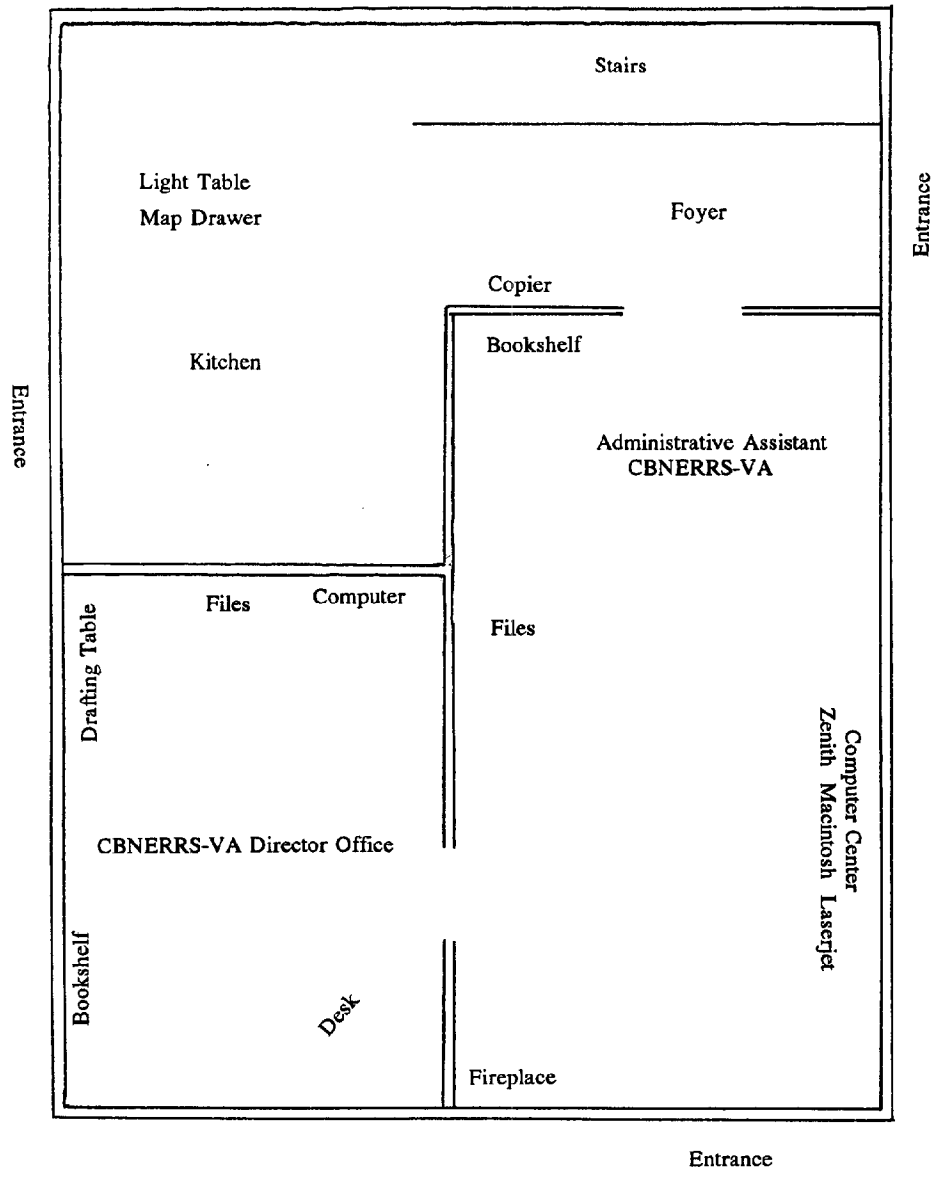


Figure 22
SECOND-FLOOR OFFICES IN BROWN HOUSE, VIMS

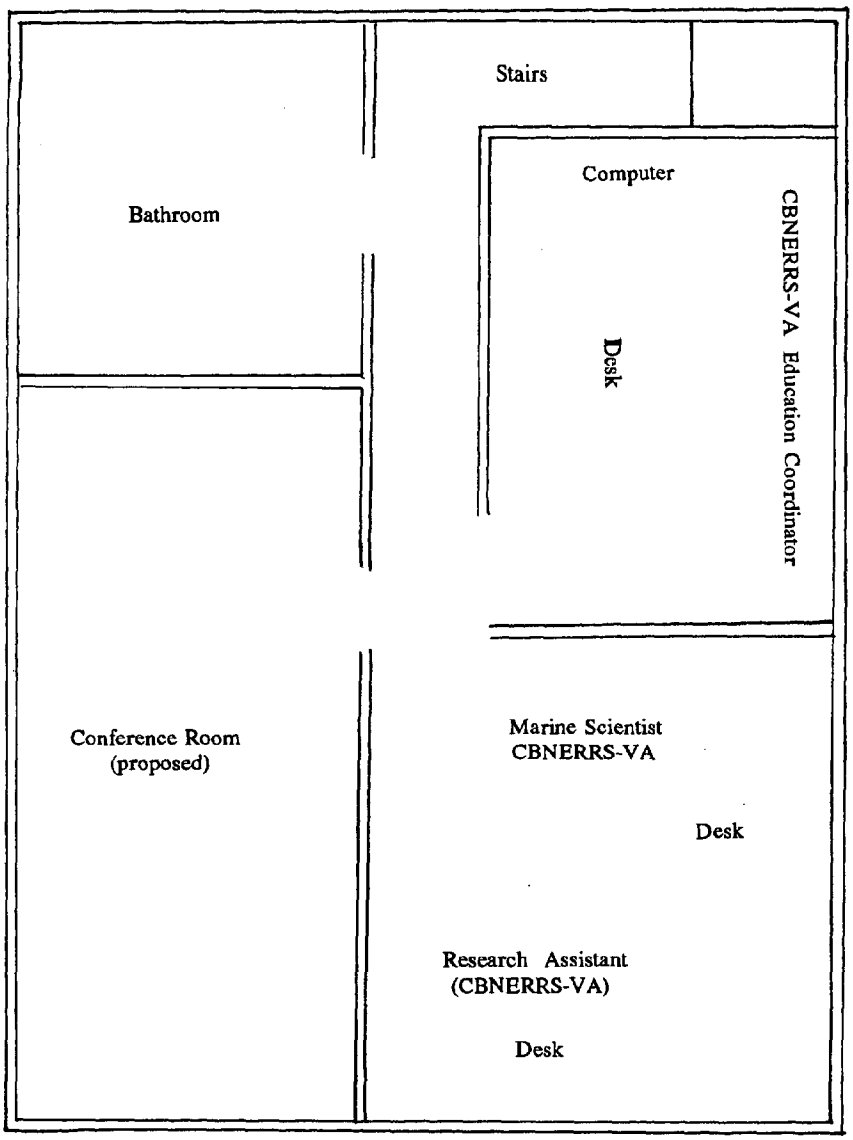


Table 16
DISTANCES AND TRAVEL TIMES BETWEEN VIMS AND RESERVE SITES

	By land	*By water*
Goodwin Islands	Not accessible	5 nmi, 20 min.
Catlett Islands	9 mi, 15 min.	5 nmi, 20 min.
Taskinas Creek	38 mi., 40 min.	14 nmi, 56 min
Sweet Hall Marsh	45 mi, 50 min	34 nmi, 1h, 16 min

ist. On the western portion, pedestrian and equestrian access will be discouraged to preclude disturbance of natural wetlands and woodlands. New facilities and improvements to public access are proposed for the eastern portion of Taskinas Creek only. No facilities or improvements are proposed for the western portion of Taskinas Creek. Tables 17 and 18 list facilities at York River State Park that are used as staging areas for education, interpretation and research activities involving Taskinas Creek. A few of these are:

Visitor center with interpretive displays and exhibits, offices, information center, and classroom (see Figures 23 and 24);
Parking lots (a main lot for 60 cars, adjacent gravel lot for 75 cars, and horse trailer facility for 30-35 vehicles);
Boat launching facility with two paved ramps, parking for 60 vehicles and trailers, restrooms, information kiosk, and pipe safe for fee collection;
Picnic shelters with picnic tables, trash cans, grills and recreational facilities;
Amphitheater for 75 people;
Canoe access to Taskinas Creek;
More than 14 miles of trails; and
Contact stations at the main entrance to the park and at Croaker Landing.

SWEET HALL MARSH Current access policies enable VIMS scientists to keep a Jonboat with motor and a storage trailer for equipment at the Sweet Hall Marsh landing. The Tacoma Hunting and Fishing Club pier is used by VIMS for mounting a tide gauge and collecting water samples.

FACILITY AND IMPROVEMENT NEEDS

The following facilities and improvements are recommended to facilitate educational, interpretive and research use of Reserve sites:

Construction or renovation of a research and education center to provide a dormitory, kitchen, commons, laboratories (wet and dry labs), classroom, reference library, offices and storage space;
Expansion of the existing auditorium in the visitor center of York River State Park to accommodate meetings of 30 to 40 people (a class-size group) and to provide modern audiovisual projection (i.e., wrap-around screen, multiple projectors and stereo sound equipment);
Incorporation of a bookstore within the visitor center of the park;
Trash receptacles at Reserve sites to encourage and facilitate anti-littering and separation of trash that can be recycled locally (glass, aluminum, computer paper, newspaper and mixed paper);
Weather station and tide gauges with appropriate instruments at Reserve sites;
Improvements to Taskinas Creek Trail to remedy erosion problems, as described in the Restoration Plan; and
Improvements to the boat launch area beside the boathouse at Sweet Hall Marsh to facilitate the launching of small, trailerable boats and to eliminate erosion resulting from launching Jonboats and canoes from the bank.

Table 17
RECREATION AND PARK FACILITIES AT YORK RIVER STATE PARK

Croaker Landing Boat Facility
3 wooden piers
1 large cement ramp
1 information kiosk
3 streetlights, 2 poles
1 contact station
3 dredge spoil ponds
riprap along York River shoreline
1 rest room facility with stairs, landscaping and benches
1 pipe safe
1 wooden safety bumper
60 vehicle surface treatment parking lot
1 well house
1 wooden gate at service road
1 wooden gate at fire road entrance
barbed-wire fence along north and east boundaries

Main Entrance Road
1 entrance sign and landscaping
2 rows white ash trees along right-of-way
2 rows of loblolly pine along right-of-way
1 wooden entrance gate
625 feet of guard rail on the right side of entrance road
652.5 feet of guard rail on the left side of entrance road
gravel shop road
1 chief ranger residence and storage shed
1 seasonal residence
1 dumpster
1 well
1 shop compound with 2 buildings and chain-link fence
1 contact station
1 rest rooms

Visitor Center Facility
1 pumphouse
1 visitor center
landscaping with wooden rails, benches
1 amphitheater with 6 wooden benches approximately 44 feet long
825 feet of split rail fence running to picnic shelters 1 and 2

Picnic Shelters 1 and 2 Facilities
1 information kiosk
5 pieces of wood and metal playground equipment
1 horseshoe pit with 55 feet of split rail
1 trail box with brochures
2 picnic shelters

Picnic Shelter 3 Facility
1 set of volleyball posts
1 horseshoe pit with 110 feet of split rail
1 phone box
473 feet of split rail fence along York River shoreline
1 set of steps with floating platform

Woodstock Pond Facility
4 fishing docks 20 feet long
1 well house

Canoe Launch Area
1 floating dock
1 metal canoe rack
1 set of wooden steps
1 wooden storage box

Southern Region
1 superintendent residence and storage shed
1 well house
1 set of ruins along Riverview Plantation boundary
1 black metal pole gate across Backbone Trail

Throughout the Park
17 trash cans
54 signs in various sizes
1 power line and poles
27 grills
65 picnic tables
30 assorted benches

Table 18
BUILDINGS AT YORK RIVER STATE PARK
Numerals denote year of construction and area (ft^2)

Residence, Superintendent	1977	1,100	Shelter, Picnic, small	1978	360
Shed, Storage, Superintendent	1978	120	Shop, maintenance	1978	1,560
Well House, Superintendent	1977	64	Storage, fuel	1984	32
Visitor Center	1978	3,000	Shed, Equipment	1984	968
Pump Building, Sewer, V.C.	1978	100	Contact Station	1980	32
Well House, V.C.	1978	100	Residence, Chief Ranger	1985	1,116
Restroom, Boat Landing	1978	300	Shed, Storage, Superintendent	1977	288
Well House, Boat Landing	1978	100	Trailer	1985	450
Shelter, Picnic, small	1978	360	Contact Station	1988	32
Shelter, Picnic, large	1978	820	Shed, Storage, Chief Ranger	1985	108

Figure 23
EAST WING OF VISITOR CENTER, YORK RIVER STATE PARK

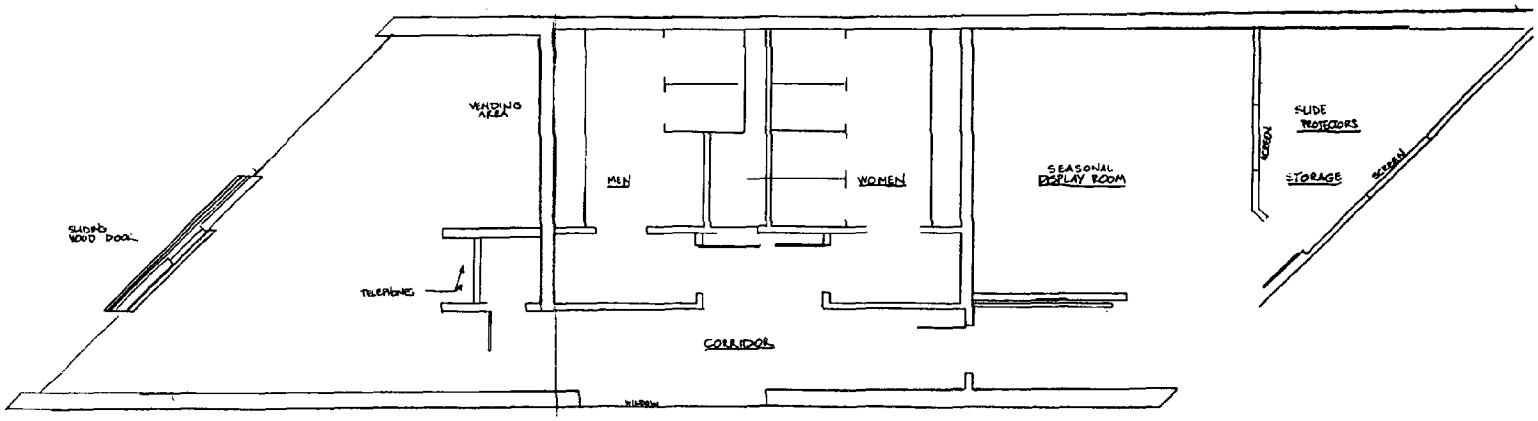
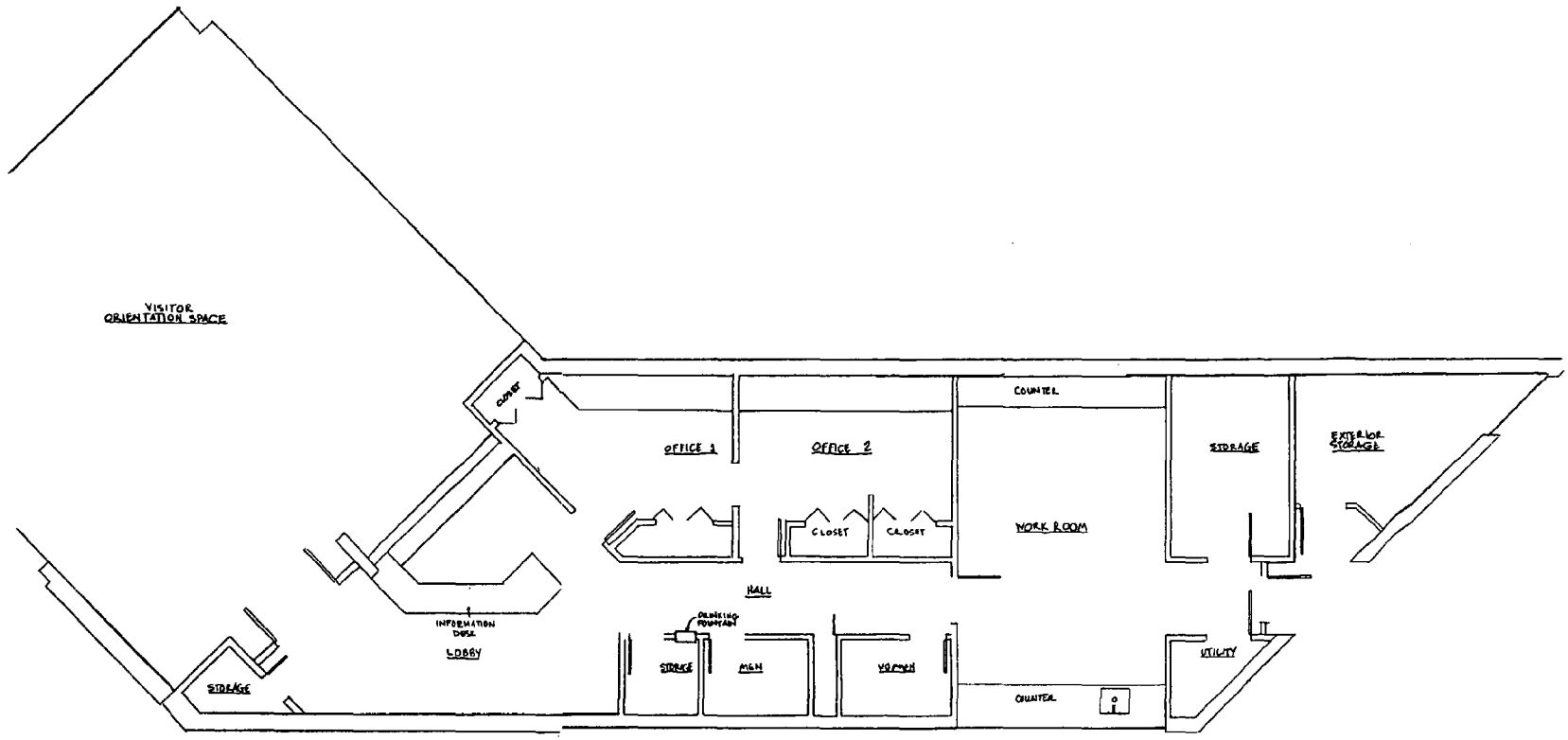


Figure 24
WEST WING OF VISITOR CENTER, YORK RIVER STATE PARK



REFERENCES

Abbott Associates. 1975. Draft environmental assessment of York River State Park Phase I. Williamsburg, Va.

Abbott Associates. 1987. Report on findings: A prehistoric Indian site in York River State Park. Williamsburg, Va.

Ablowich, D.A., landowner, Catlett Islands, in a letter dated Nov. 17, 1985, to the assessor, Gloucester County, regarding condition of cottage on the Catlett Islands, on file at the Virginia Institute of Marine Science, Gloucester Point, Va.

Anderson, G.L., G.B. Williams, M.H. Peoples, P. Rosen and C.H. Hobbs III. 1975. Shoreline situation report: York County, Virginia. Virginia Institute of Marine Science, Spec. Rpt. Appl. Mar. Sci. and Ocean Eng. No. 82. 62 p.

Anderson, G.L., G.B. Williams, M.H. Peoples, P. Rosen and L. Weishar. 1976. Shoreline situation report: Gloucester County, Virginia. Virginia Institute of Marine Science, Spec. Rpt. Appl. Mar. Sci. and Ocean Eng. No. 83. 71 p.

Baliles, G.L., Governor of Virginia. 1987, in a letter dated Sept. 30, 1987, to Dr. Maurice P. Lynch, Associate Dean, School of Marine Science, College of William and Mary, on file at the Virginia Institute of Marine Science, Gloucester Point, Va.

Baliles, G.L., Governor of Virginia. 1989a, in a letter dated March 23, 1988, to Governor William Donald Schaefer, Governor of Maryland, on file at the Virginia Institute of Marine Science, Gloucester Point, Va.

Baliles, G.L., Governor of Virginia. 1989b, in a letter dated March 23, 1989, to Mr. Joseph A. Uravitch, Chief, Marine and Estuarine Management Division, OCRM, NOAA, on file at the Virginia Institute of Marine Science, Gloucester Point, Va.

Bender, M.E., and D.L. Correll. 1974. The use of wetlands as nutrient removal systems. Chesapeake Research Consortium Publication 29.

Bender, M.E. 1974. Report on water quality data evaluation and program design services for the James and York rivers in conjunction with "208" planning program for the Tidewater Region of Virginia. Submitted to Hampton Roads Water Quality Agency by the Virginia Institute of Marine Science. 303 p.

Bender, M.E. 1986. The York River: A brief review of its physical, chemical and biological characteristics. VIMS Classified.

Bohne, R. 1987. In a letter dated Dec. 10, 1987, to Ms. Carroll N. Curtis, Director, Chesapeake Bay National Estuarine Research Reserve System in Virginia, on file at the Virginia Institute of Marine Science, Gloucester Point, Va.

Brehmer, M.L. 1970. Biological and chemical study of Virginia's estuaries. VIMS master's thesis.

Brooks, T.J. 1983. Pamunkey River slack water data report: Temperature, salinity, dissolved oxygen 1970-1980. VIMS Data Report 20.

Brooks, T.J. 1983. York River slack water data report: Temperature, salinity, dissolved oxyen, 1971-1980. VIMS Data Report 19.

Buttleman, K.J., Administrator, Council on the Environment. 1985, in a letter dated June 26, 1985 to Dr. Nancy Foster, Chief, Sanctuary Programs Division, OCRM, NOAA, on file at the Virginia Institute of Marine Science, Gloucester Point, Va.

Causey, M.H. 1984. The effect of beaver (*Castor canadensis*) dams on the vegetation of tidal marshes. VIMS master's thesis.

Chesapeake Bay National Estuarine Research Reserve System in Virginia. 1991. Final environmental impact statement and final management plan. Virginia Institute of Marine Science, Gloucester Point. 258 pages plus appendices.

Chesapeake Executive Council. 1987. The Chesapeake Bay agreement. 12 p. Annapolis, Md.

Chesapeake Executive Council. 1988a. Comprehensive research plan for the Chesapeake Bay Program. Agreement Commitment Report. Washington, D.C.

Chesapeake Executive Council. 1988b. Living marine resource monitoring plan for the Chesapeake Bay Program. Agreement Commitment Report. Washington, D.C.

Chesapeake Executive Council. 1988c. Population growth and development in the Chesapeake Bay watershed to the year 2020: The report of the Year 2020 Panel to the Chesapeake Executive Council. 72 p.

Clark, J.R. 1982. Assessing the National Estuarine Sanctuary Program. A report to the Office of Coastal Zone Management under Purchase Order NA81AAA03317. Washington, D.C.

Cole, D.N., and J.L. Marion. 1988. Recreational impacts to some riparian forests of the eastern United States. Environ. Mgmt. 12(1): 99-107.

Connly, M. 1987. Research permit application to York River State Park. Science department chairman, Williamsburg Christian Academy. Williamsburg, Va.

Council on Environmental Quality. 1988. Environmental quality 1986. 17th annual report of the Council on Environmental Quality together with the president's message to Congress. (Washington, D.C.), p. 180.

Council on the Environment. 1987. Progress report of Virginia's Chesapeake Bay Program. Commonwealth of Virginia, Richmond, Va. 63 p.

Cowardin, L. M., V. Carter, F.C. Golet and E.G. LaRoe. 1979. Classification of deepwater and wetlands of the United States. U.S. Fish and Wildlife Service. Washington, D.C.

Curtis, C.N., and M.P. Lynch. 1987. The site selection process for a Chesapeake Bay National Estuarine Research Reserve System, pp. 621-630. In: Lynch, M.P., and K.L. McDonald (eds.), Proc. 10th Natl. Conf. Coastal Soc., Estuarine and Coastal Management: Tools of the Trade. New Orleans, La., Oct. 12-15, 1986. Volume 2.

Department of Conservation and Historic Resources. 1980. Virginia state parks regulations. Commonwealth of Virginia. Richmond, Va.

Department of Conservation and Recreation, Division of State Parks. 1989. Natural resource management plan (draft). 80 p. Richmond, Va.

Dill, A.T. 1984. York river yesterdays. The Donning Company, Norfolk, Va. 190 p.

Division of Parks and Recreation. 1985. Interpretive prospectus for York River State Park. Department of Conservation and Historic Resources. Commonwealth of Virginia. Richmond, Va.

Division of Parks and Recreation. 1986. Interpretive programs schedule for York River State Park. (Brochure). Department of Conservation and Historic Resources. Commonwealth of Virginia. Richmond, Va.

Doumlele, D.G. 1979. New Kent tidal marsh inventory. Virginia Institute of Marine Science, Spec. Rpt. Appl. Mar. Sci. and Ocean Eng. 208.

Dubay, C. I. 1987. Research permit application to York River State Park. Science teacher, Lafayette High School, Williamsburg, Va.

Egloff et al. 1988. Archaeological investigations at Croaker Landing: Project 44JC70 and 44JC71. Department of Conservation and Historic Resources, Division of Historic Landmarks. Richmond, Va.

Environmental Protection Agency. 1983a. Chesapeake Bay: a framework for action. U.S. EPA Chesapeake Bay Program. Annapolis, Md. 185 p.

Environmental Protection Agency. 1983. Chesapeake Bay: A profile of environmental change. Segmentation scheme (adapted from Klein, unpubl.). Washington, D.C.

Environmental Protection Agency. 1983. Chesapeake Bay: a profile of environmental change. U.S. EPA Chesapeake Bay Program. Annapolis, Md. 200 p.

Environmental Protection Agency. 1989. National coastal and marine policy. Washington, D.C.

Environmental Protection Agency. 1989. Final determination of the U.S.Environmental Protection Agency's assistant administrator for Water pursuant to Section 404(c) of the Clean Water Act concerning the proposed Ware Creek Water Supply impoundment, James City County, Virginia. Washingon, D.C.

Finkelstein and Hardaway. 1988. Late Holocene sedimentation and erosion of estuarine fringing marshes, York River, Virginia. J. Coastal Res. 4(3): 447-456.

Fish and Wildlife Service, U.S. Department of the Interior. 1989. Position of the U.S. Fish and Wildlife Service on the need for project-specific modeling of salinity intrusion in the Pamunkey River resulting from the proposed withdrawal by Hanover County, Virginia. In: a letter to Col. J.J.Thomas. District Engineer, Norfolk District, Corps of Engineers dated Jan. 26, 1989, from J.P. Wolflin, Supervisor, Annapolis Field Office, Fish and Wildlife Service on file at VIMS.

Frazer, G.D. 1985. York and Pamunkey rivers navigation study, biological resources and ecology of the upper York and lower Pamunkey rivers. U.S. Fish and Wildlife Service Planning Aid Report.

Frey, R.W., and P.B. Basan. 1986. Coastal salt marshes. In: Coastal sedimentary environments (R.A. Davis, ed.). Springer-Verlag, New York, 101-159.

Gleason, M.L., and J.C. Zieman. 1981. Influence of tidal inundation on internal oxygen supply of *Spartina alterniflora* and *Spartina patens*. Estuarine, Coastal and Shelf Sci. 13: 47-57.

Gloucester County. 1980. Gloucester County comprehensive plan. 88 p. Gloucester County, Va..

Gray, J.R. 1985. Geology of the late Pleistocene ridge and swale system, Poquoson, Virginia. Senior research paper, The College of William and Mary, 24 p.

Harris, M.H. 1977. Old New Kent County: Some account of the planters, plantations and places in King William County, St. John's Parish. Volume II, pp. 582-614.

Harvill, A.M., Jr. 1965. Plants from the Peninsula of Virginia. Va. J. Sci. 16(3): 243-247.

Haven, D.S., J.P. Whitcomb, and Kendall. 1981. The present and potential productivity of the Baylor grounds in Virginia, Vol. 1. Virginia Institute of Marine Science, Spec. Rpt. Appl. Mar. Sci. and Ocean Eng. No. 243. 167 p.

Hershner, C. 1987. Forested buffer zones: Pilot studies on efficiency in reducing surface and shallow groundwater nutrient inputs to estuarine waters. Report prepared for the Virginia Department of Conservation and Historic Resources, Division of Soil and Water Conservation. 59 p.

Hobbs, C.H., G.L. Anderson, M.A. Patton, and P. Rosen. 1975. Shoreline situation report for James City County, Virginia Institute of Marine Science, Spec. Rpt. Appl. Mar. Sci. and Ocean Eng. 81. Virginia Institute of Marine Science, Gloucester Point, Va.

Hobbs, C.H., III, et al. 1975a. Shoreline situation report, New Kent, King William and King and Queen counties. Virginia Institute of Marine Science, Spec. Rpt. Appl. Mar. Sci. and Ocean Eng. 99 and Chesapeake Research Consortium Report 44.

House Report (99-103). 1985. Coastal Zone Management Reauthorization Act of 1985. Prepared by the Committee of Merchant Marine and Fisheries to accompany House Resolution 2121.

Huggett, R.J. 1977. Copper and zinc in bottom sediments and oysters, *Crassostrea virginica*, from Virginia's estuaries. Ph.D. diss., VIMS, 113 p.

Huggett, R.J., et al. 1971. Mercury in sediments from three Virginia estuaries. Ches. Sci. 12(4), 280-282.

Hyer, P.V. 1977. Water quality model of York River, Virginia. Virginia Institute of Marine Science, Spec. Rpt. Appl. Mar. Sci. and Ocean Eng. No. 146. 71p.

Jenkins, D.W. 1974. Natural areas of the Chesapeake Bay region: ecological priorities. A report prepared by the Center for Natural Areas, Ecology Program, Smithsonian Institution, Washington, D.C.

Johnson, G.H. 1972. Geology of the Yorktown, Poquoson West, and Poquoson East quadrangles, Virginia. Virginia Division of Mineral Resources Rept. Inv. 41, 57 p.

Johnson, L.F. 1990. Personal interview.

Jones, S.M. 1975. Timberland examination report on the lands of D.A. Ablowich, Gloucester County, Va. 2 p.

Jordan, R.A., M.E. Bender and D. Markle. 1972. The environment and biological community of the lower York River, Virginia: a literature review. VIMS Rept. for the Virginia Electric Power Company. 231 p.

Kopia, A. 1986. A comparison of wildlife and plantlife on north and south facing slopes at York River State Park. Student project, Lafayette High School, Williamsburg, Va.

Ledwin, J. 1988. Sedimentation and nutrients in a tidal freshwater marsh. VIMS master's thesis. 89 p.

Leonard, L.A. 1986. The stratigraphy, origin and development of the Goodwin Islands near Seaford, Virginia. Senior research paper, The College of William and Mary. 142 p.

Library of Congress Congressional Research Service. 1976. Legislative history of the Coastal Zone Management Act of 1972, as amended in 1974 and 1976 with a section-by-section index. Prepared at the request of The Honorable Warren G. Magnuson, Chairman, Committee on Commerce, and The Honorable Ernest F. Hollings, Chairman, National Ocean Policy Study, pursuant to Senate Resolution 222. Washington, D.C.

Lynch, M.P., and A.H. Humphreys Jr. 1987. Briefing paper on the Goodwin Islands and the National Estuarine Research Reserve Program. A paper prepared for the trustees of the Endowment Association of The College of William and Mary in Virginia Inc. dated April 22, 1987. 2 p.

Malcolm Pirnie Inc. 1990. Lower Virginia Peninsula regional raw water supply study. 9 p., plus figures. Newport News, Va.

Marcellus, K.L., G.M. Silberhorn and G.M. Dawes. 1973. An assessment of the potential environmental effects of the proposed marina at York River State Park. Virginia Institute of Marine Science, Gloucester Point, Va 23062.

McCartney, M. 1990. Personal interviews.

Mixo, R.B. 1985. Stratigraphic and geomorphic framework of uppermost Cenozoic deposits in southern Delmarva Peninsula, Virginia and Maryland. U.S. Geological Survey Prof. Paper 1067-G, 53 p.

Money, P.A., and T. Moeslein. 1986. Goodwin Islands quick look report. A report of field work conducted Oct. 7, 1986, by the Peninsula Nature and Science Center. 3 p.

Moore, K.A. 1976. Gloucester County tidal marsh inventory. Virginia Institute of Marine Science, Spec. Rpt. Appl. Mar. Sci. and Ocean Eng. 64. 103 p.

Moore, K.A. 1980. James City County tidal marsh inventory. Virginia Institute of Marine Science, Spec. Rpt. Appl. Mar. Sci. and Ocean Eng. 188.

National Oceanic and Atmospheric Administration. 1987a. Guidelines for establishing proposed boundaries for National Estuarine Research Reserves (draft). 7 p.

National Oceanic and Atmospheric Administration. 1987b. National Estuarine Reserve Research System research plan. Washington, D.C.

National Science Foundation. 1978. A pilot program for long-term observation and study of ecosystems of the United States. Report of a second conference on long-term ecological measurements. Woods Hole, Mass.

National Science Foundation. 1979. Long-term ecological research: concept statement and measurement needs. Summary of a workshop. Indianapolis, Ind.

National Science Foundation. 1981. Experimental ecological reserves. Final report on the network. Indianapolis, Ind.

National Wetlands Inventory. 1986. Atlas of national wetlands inventory maps, Vol. 1, coastal plain Virginia western shore. U.S. Fish and Wildlife Service, Annapolis, Md.

Odum, W.E. 1984. The ecology of tidal freshwater marshes of the United States East Coast: A community profile. U.S. Fish and Wildlife Serv. Rept. 83/17.

Orth, R., J. Simons, R. Allaire, V. Carter, L. Hindman, K. Moore and N. Rybicki. 1985. Distribution of submerged aquatic vegetation in the Chesapeake Bay and tributaries: 1984. Prepared for U.S. EPA. Coop. Agreement X-003301-01. 155 p.

Orth, R., J. Simons, J. Capelli, V. Carter, A. Frisch, L. Hindman, S. Hodges, K. Moore and N. Rybicki. 1987. Distribution of submerged aquatic vegetation in the Chesapeake Bay and tributaries and Chincoteague Bay: 1986. 180 p.

Patten, B.C. 1962. Synoptic comparison of seston loads in the Rappahannock, York and James rivers. VIMS master's thesis.

Perry, J.E. 1988. Wetlands department, Virginia Institute of Marine Science. Pers. comm.

Reay, W.G. 1989. Subsurface hydrodynamics and nutrient exchange within an extensive tidal freshwater wetland. VIMS master's thesis.

Richards, C.E. 1962. A survey of salt-water sport fishing in Virginia, 1955-60. Ches. Sci. 3(4):223-235.

Samuels, R.A., and K. Drescher. undated. Economic and environmental impact of the Goodwin Island development project. 32 p.

Schubel, J.R. 1986. Life and death of the Chesapeake Bay. U. Md. Sea Grant Coll. Publ. UM-SG-86-01. College Park, Md.

Seaman, M. 1987. Research permit application to York River State Park. Science teacher, Williamsburg Christian Academy, Williamsburg, Va.

Settle, Fax. 1989. Personal communication.

Shrader, T. 1988. Superintendent, York River State Park. Pers. comm.

Silberhorn, G.M. 1985. Chesapeake Bay freshwater wetlands: Status and research needs. pp. 25-29, In: Groman, H.A., T.R. Henderson, E.J. Meyers, D.M. Burke, and J.A. Kusler (eds). Proceedings of the Conference: Wetlands of the Chesapeake. Easton, Md. (April 9-11, 1985).

Silberhorn, G.M. 1981. York County and Town of Poquoson tidal marsh inventory. Va. Institute of Marine Science, Spec. Rpt. Appl. Mar. Sci.and Ocean Eng. 53. 67 p.

Silberhorn, G.M., and A.W. Zacherle. 1987. King William County and Town of West Point tidal marsh inventory. Virginia Institute of Marine Science, Spec. Rpt. Appl. Mar. Sci. and Ocean Eng. 289. 56p.

Silberhorn, G.M., and C.H. Hershner, in prep. Goodwin Islands burn study.

Smith, S.M. 1984. Community and trophic organization of nekton utilizing shallow marsh habitats, York River, Virginia. Fish. Bull. 82(3):455-467.

South, W.D. 1969. Investigation of the effect of mill waste on water quality in the Pamunkey and York rivers. Chesapeake Corporation of Virginia, West Point, Va.

Spells, A.J., and G.D. Frazer. 1984. York and Pamunkey rivers navigation study. A literature review of fish and wildlife resources within the potential project impact area. 50 p.

Stratton Commission. 1969. Our nation and the sea: A plan for action. Report of the Commission on Marine Science, Engineering and Resources. Washington, D.C.

Sturm, S.C., and B.J. Neilson. 1977. Water quality in the York River. Virginia Institute of Marine Science, Spec. Rpt. Appl. Mar. Sci. and Ocean Eng. 130. 55 p.

Uravitch, J.A. 1989a, in a memorandum dated January 27, 1989, to National Estuarine Research Reserve System managers on file at the Virginia Institute of Marine Science, Gloucester Point, Va.

Uravitch, J.A. 1989b, in a letter dated May 16, 1989, to Dr. Frank O. Perkins, Dean/Director, Virginia Institute of Marine Science, on file at the Virginia Institute of Marine Science, Gloucester Point, Va.

U.S. Army Corps of Engineers. 1930. Pamunkey River, Virginia, York River System. U.S. House of Representatives Document 54.

U.S. Army Corps of Engineers. 1970. Review of Reports on the York and Pamunkey rivers, Virginia. Norfolk District, Va.

U.S. Army Corps of Engineers. 1987. Taskinas Creek Virginia. An assessment of proposed channelization of Taskinas Creek. Prepared by the Norfolk District (February 17, 1969), Norfolk, Va.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National estuarine sanctuary program regulations, final rule. Federal Register Vol. 49(125), 15 CFR Part 921.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration. 1987. Tide tables of the east coast of North and South America.

U.S. Geological Survey, New Kent topographic map, 1978.

U.S. Geological Survey. 1957. Surface water supply of the United States. Part 1-B: North Atlantic Slope basins, New York to York River. U.S. Geological Survey Water-Supply Paper 1502.

Van Engel, W.A. 1968. Characterization of coastal and estuarine fish and nursery grounds as natural communities. Final Rpt. of VIMS Comm. Fish. Res. and Dev. Act Proj. to U.S. Bur. Comm. Fish. 43 p.

Virginia Archaeological Services Inc. 1988. A Phase I archaeological survey of the proposed Stonehouse development, James City County, New Kent County, Virginia. James City County Planning Department, Williamsburg, Va.

Virginia Division of Water Resources. 1970. York River basin: Comprehensive water resources plan. Planning Bulletin 227.

Virginia Estuarine Research Reserve System. 1988. Floristic data from the Catlett Islands, lower York River, Virginia

Virginia Institute of Marine Science. 1985a. A proposal to establish and implement a site selection process for a Chesapeake Bay National Estuarine Sanctuary in Virginia. Submitted to the Office of Ocean and Coastal Resource Management, NOAA.

Virginia Institute of Marine Science. 1985b. A detailed description of the site selection and public participation process for a Chesapeake Bay National Estuarine Sanctuary in Virginia. Submitted to the Office of Ocean and Coastal Resource Management, NOAA.

Virginia Institute of Marine Science. 1987a. A quarterly report on the site selection and public participation process for a Chesapeake Bay National Estuarine Sanctuary in Virginia, plus attachments. Submitted to the Office of Ocean and Coastal Resource Management, NOAA.

Virginia Intitute of Marine Science. 1987b. A quarterly and final report on the site selection and public participation process for a Chesapeake Bay National Estuarine Sanctuary in Virginia, plus attachments. Submitted to the Office of Ocean and Coastal Resource Management, NOAA.

Virginia Institute of Marine Science. 1989. The Chesapeake Bay National Estuarine Research Reserve System in Virginia: Site nominations and application for preacquisition assistance. The College of William and Mary (Gloucester Point, Va), 310 p.

Virginia Marine Resources Fishery Commission. 1987. Fish catch data from the Coleman Bridge to York River Mouth, including Back Creek and the Thorofare (as of 11/12/87).

Virginia Marine Resources Fishery Commission. 1988. Fish catch data for the York River, from Claybank to the Coleman Bridge (as of 3/23/88).

Virginia State Water Control Board. 1980. Public, leased and condemned shellfish-growing areas in the Commonwealth of Virginia. Va. State Water Control Board Info. Bull. 541.

Virginia Water Control Board. 1989. Tributary water quality 1987 characterization report. Va. Water Control Board Basic Data Bull. 77.

Weigmann, D.L., and C.J. Kroehler. 1988. Threats to Virginia's groundwater. Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University, Blacksburg, Va.

Wilstach, P. 1929. Tidewater Virginia. Bobbs-Merrill Co., Indianapolis, Ind. 326 p.

Williamsburg Bird Club. 1982. Checklist of birds observed at York River State Park. Williamsburg Bird Club, Williamsburg, Va.

York River State Park staff. 1985. Project suggestions for York River State Park (in-house memorandum). York River State Park, Division of Parks and Recreation, Williamsburg, Va.

York River State Park staff. 1986. Interpretive guide to canoe tours (in-house memorandum). York River State Park, Division of Parks and Recreation, Williamsburg, Va.

Zacherle, A.W. 1984. A method for evaluating the long-term, cumulative impacts of tidal marsh alterations: The York River System: A case study. VIMS master's thesis.

Zieman, J.C., R.L. Wetzel, and S.A. Macko (in progress). Isotopic determination of nitrogen sources and processing in Chesapeake Bay. Research proposal funded by National Sea Grant Program, Rockville, Md.

APPENDIX A
CONSERVATION EASEMENTS, MANAGEMENT AGREEMENTS AND MEMORANDA OF UNDERSTANDING

MEMORANDUM OF UNDERSTANDING
BETWEEN
VIRGINIA INSTITUTE OF MARINE SCIENCE
COLLEGE OF WILLIAM AND MARY
THE COMMONWEALTH OF VIRGINIA
AND
THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
CONCERNING THE
ESTABLISHMENT AND ADMINISTRATION OF THE
CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM IN VIRGINIA

WHEREAS, the Commonwealth of Virginia has determined that the waters and related coastal habitats of Goodwin Islands, Catlett Islands, Taskinas Creek, and Sweet Hall Marsh provide unique opportunities to study natural and human processes occurring within an estuarine ecosystem; and

WHEREAS, it is the finding of the Commonwealth of Virginia that the resources of Goodwin Islands, Catlett Islands, Taskinas Creek and Sweet Hall Marsh and the values they represent to the citizens of Virginia and the United States will benefit from the management of these sites as a multiple site National Estuarine Research Reserve; and

WHEREAS, the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce has concurred with that finding and pursuant to its authority under Section 315 of the Coastal Zone Management Act of 1972, as amended (CZMA), P.L. 92-583, 16 U.S.C. 1461, and in accordance with implementing regulations at 15 CFR 921.30, may designate Goodwin Islands, Catlett Islands, Taskinas Creek, and Sweet Hall Marsh components of a National Estuarine Research Reserve, forming a multiple site Chesapeake Bay National Estuarine Research Reserve System in Virginia; and

WHEREAS, the Virginia Institute of Marine Science, within the College of William and Mary, as the agency designated by the Governor of the Commonwealth of Virginia responsible for managing the Chesapeake Bay National Estuarine Research Reserve System in Virginia, acknowledges the need and requirement for continuing State-Federal cooperation in the long-term management of the sites in a manner consistent with the purposes sought through their designation.

NOW, THEREFORE, in consideration of the mutual covenants contained herein it is agreed by and between the Commonwealth of Virginia and NOAA, effective on the date of the designation of Goodwin Islands, Catlett Islands, Taskinas Creek, and Sweet Hall Marsh as components of the Chesapeake Bay National Estuarine Research Reserve System in Virginia as follows:

ARTICLE I: State-Federal Roles in Reserve Management

A. The Virginia Institute of Marine Science within the College of William and Mary as the principal contact for the Commonwealth of Virginia in all matters concerning the Chesapeake Bay National Estuarine Research Reserve System in Virginia, will serve to ensure

that the Reserve is managed in a manner consistent with the goals of the National Estuarine Research Reserve System and the management objectives of the approved Management Plan. Its responsibilities for Management Plan implementation will include the following:

1. Effect and maintain a process for coordinating and facilitating the roles and responsibilities of all State and county agencies involved in the management of the Reserve, including but not limited to:

   a. Enforcement programs regulating water quality, fish and wildlife habitat protection, sport and commercial fisheries, and non-consumptive recreational activities;

   b. The on-site administration of facilities, programs, and tasks related to Reserve management;

   c. Activities and programs conducted pursuant to the State's Federally-approved coastal management program authorized under Section 306 of the CZMA; and

   d. Research and educational agenda developed and implemented in accordance with corresponding elements of the proposed Plan;

2. As the Governor's designee under 15 CFR 921.50 and recipient State entity in matters concerning all financial assistance awards authorized under Section 315 of the CZMA, apply for, budget, and allocate such funds recieved for acquisition and development, operation and management, and research, monitoring and education;

3. Serve as principal negotiator on issues involving proposed boundary changes and/or amendments to the Management Plan;

4. Submit annual reports to NOAA on the Reserve describing, in accordance with 15 CFR 921.34, program performance in Plan implementation and a detailed work program for the following year of Reserve operations, including budget projections and research efforts;

5. Respond to NOAA's requests for information and to evaluation findings made pursuant to to Section 312 of the CZMA; and

6. In the event that it should become necessary, based on findings of deficiency, serve as the point-of-contact for the Commonwealth of Virginia in actions involving the possible withdrawal of Reserve designation, as provided at 15 CFR 921.35.

B. Within NOAA, the Marine and Estuarine Management Division (MEMD), Office of Ocean and Coastal Resource Management (OCRM), will serve to administer the provisions of Section 315 of the CZMA to ensure that the Chesapeake Bay National Estuarine Research Reserve in Virginia is managed in accordance with the goals of the National

Estuarine Reserve Research System and the Management Plan. In carrying out its responsibilities, the MEMD will:

1. Subject to appropriation, provide financial assistance to the State, consistent with 15 CFR 921 for acquisition, development, management and operation of the Reserve;

2. Subject to appropriation, provide financial assistance to the State and other eligible entities on a competitive basis for research and monitoring and education programs at the Reserve;

3. Serve as the point-of-contact for NOAA in discussion regarding applications for and any financial assistance received by the State under Section 315 of the CZMA, including any and all performance standards, compliance schedules, or Special Award Conditions deemed appropriate by NOAA to ensure the timely and proper execution of the proposed work program;

4. Participate in periodic evaluations scheduled by OCRM in accordance with Section 312 of the CZMA to measure the State's performance in Plan implementation and its compliance with the terms and conditions prescribed in financial assistance awards granted by NOAA for the purposes of the Reserve and advise appropriate OCRM staff of existing or emerging issues which might affect the State's coastal management program; and

5. Establish an information exchange network cataloging all available research data and educational material developed on each site included within the national system of estuarine research reserves.

ARTICLE II: Real Property Acquired for the Purposes of the Reserve

A. The Commonwealth of Virginia agrees to the conditions set forth at 15 CFR 921.21 (e) which specify the legal documentation requirements concerning the use and disposition of real property acquired for Reserve purposes with Federal funds under Section 315 of the CZMA.

B. The Commonwealth of Virginia agrees to take appropriate action to ensure the long-term protection, operation, and mangement of the reserves pursuant to Section 315 of the CZMA.

ARTICLE III: Program Evaluation

A. During the period that Federal financial assistance is available, OCRM will schedule, pursuant to 15 CFR 921.34, periodic evaluations of the State's performance in meeting the conditions of such awards and progress in implementing the Plan and the provisions of this MOU. Where findings of deficiency occur, NOAA may initiate action in accordance with the procedures established at 15 CFR 921.35.

B. After Federal financial assistance under Section 315 of the CZMA is no longer available for the operation and management of the Reserve,

OCRM will continue to evaluate, pursuant to Section 312 of the CZMA and the corresponding provisions of 15 CFR 921, the Virginia Institute of Marine Science performance in implementing the Plan and strategy committing the State to the long-term management of the Chesapeake Bay National Estuarine Research Reserve System in Virginia. Where findings of deficiency occur, NOAA may initiate action in accordance with the procedures established at 15 CFR 921.35.

IN WITNESS THEREOF, the parties hereto have caused this Memorandum to be executed.

Timothy R.E. Keeney, Director
OCRM, NOAA
U.S. Department of Commerce
Washington, D.C. 20235

Feb. 6, 1991
Date

Paul R. Verkuil
President
College of William and Mary
Williamsburg, Virginia 23185

16 August 1990
Date

Joseph A. Uravitch, Chief
MEMD
OCRM, NOAA
U.S. Department of Commerce
Washington, D.C. 20235

2/5/91
Date

Keith J. Buttleman, Administrator
Council on the Environment
Richmond, Virginia 23219

9/11/90
Date

Witness

Date

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE VIRGINIA INSTITUTE OF MARINE SCIENCE
AND
THE DEPARTMENT OF CONSERVATION AND RECREATION
CONCERNING THE ESTABLISHMENT AND ADMINISTRATION
OF THE
CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM
TASKINAS CREEK COMPONENT

WHEREAS, the Commonwealth of Virginia, acting through the Virginia Institute of Marine Science (VIMS), has determined that the designation of Taskinas Creek within the York River State Park as a Chesapeake Bay National Estuarine Research Reserve under the National Estuarine Research Reserve Program as provided for in the Coastal Zone Management Act of 1972, as amended, would provide for beneficial long-term research and public education to improve coastal management capabilities of the Commonwealth; and

WHEREAS, the Virginia Department of Conservation and Recreation (DCR), through the Division of State Parks, owns and manages the property known as Taskinas Creek within York River State Park; and

WHEREAS, the DCR is willing to make a long-term commitment to the Reserve program by making a substantial portion of the Taskinas Creek watershed within York River State Park, along with adjacent state waters, designated as a National Estuarine Research Reserve for the purposes and in the manner set forth below and in the Natural Resource Management Plan for York River State Park and the Management Plan for the Chesapeake Bay National Estuarine Research Reserve System in Virginia; and

WHEREAS, the National Oceanic and Atmospheric Administration (NOAA), Office of Ocean and Coastal Resource Management, has approved a matching financial assistance award to establish Taskinas Creek within York River State Park as a Chesapeake Bay National Estuarine Research Reserve; and

WHEREAS, the VIMS, DCR, and NOAA recognize that the designation of Taskinas Creek within York River State Park as a research reserve is an acknowledgement that the area within the reserve is a natural field laboratory to be used, in consonance with current uses, to study and gather data on natural and human processes occurring within the watershed of this York River tributary to the lower Chesapeake Bay, and further to provide a basis for increased public awareness and understanding of the complex nature of estuarine systems, their values and benefits to man and nature, and the problems that confront them, all of which are reflective of the goals of the National Estuarine Research Reserve Program which are preservation, research, and education; and

WHEREAS, the Taskinas Creek component of the Chesapeake Bay National Estuarine Research Reserve System in Virginia will be cooperatively managed and operated by the DCR with VIMS in accordance with the Natural Resource Management Plan for York River State Park and the Management Plan for the Chesapeake Bay National Estuarine Research Reserve System in Virginia; and

WHEREAS, the establishment of the Taskinas Creek research reserve will augment the present management, educational, and research functions of the DCR within York River State Park, but shall not be used as a substitute for the present management, education, or research functions of DCR; and

WHEREAS, the disbursement of the Federal grant is conditioned upon the execution of this Memorandum of Understanding between VIMS and DCR;

NOW, THEREFORE, for and in consideration of mutual covenants herein contained, it is agreed by and between the parties the following:

ARTICLE I.-Sanctuary Boundary

The Chesapeake Bay National Estuarine Research Reserve at Taskinas Creek will include:

(1) Land presently owned by the DCR within York River State Park, as delineated on Attachment A as well as parcels acquired by DCR as additions to the CBNERRS-VA. DCR and VIMS will develop a conservation plan and a land protection strategy for land adjacent to the reserve within a fifty foot contour.

It is also agreed that the Reserve shall be identified at its boundary by the placement of signs which will be aesthetically in keeping with the unique characteristics of Taskinas Creek and York River State Park, and will be purchased with Federal financial award funds. The design will be developed by the DCR and VIMS and approved by NOAA.

ARTICLE II.-Uses of the Reserve at Taskinas Creek

That portion of the York River State Park designated as the Reserve at Taskinas Creek will be used primarily for environmental research and public education within the programs approved by the DCR Director, consistent with the purposes for which the Reserve is designated. With regard to natural resource management activities carried out in the Reserve under the approved management plan, the following condition applies. In the core area, the DCR agrees to maintain the site as an open/sensitive undeveloped zone, as defined in DCR's Land Classification System where non-manipulative research is conducted. Manipulative research and management within the Reserve will be permitted only with the agreement of the parties to this agreement on a case-by-case basis.

The Reserve will complement and where possible add to the research work at York River State Park. The research will be directed towards but not limited to: (1) a better understanding of the ecological relationships within the estuarine environment; (2) baseline ecological measurements; (3) monitoring significant changes in the estuarine environment; and (4) assessment and prediction of the effects of man's activities on the estuarine environment.

Educational programs will be designed to increase public knowledge and awareness of estuarine systems and their uses to man, and may serve as a model for similar programs elsewhere in the Bay area and in other estuarine systems.

Designation of the Reserve will not restrict passive recreational activities within the core area nor fishing and water-oriented recreational and other wildlife oriented activities which have been traditionally conducted in York River State Park, nor to contravene the manner in which these activities are regulated by appropriate law. The designation of the Reserve at Taskinas Creek is in no way meant to obstruct the achievement of the goals and objectives of the DCR as they pertain to the York River State Park. Resource conditions within the reserve will be monitored to insure that resource degradation does not occur as a result of excessive visitor use. Appropriate measures will be taken to minimize any damages observed as a result of monitoring.

ARTICLE III.- Title and Use of York River State Park

Except as specifically provided below in regard to Reserve facilities and equipment within the boundaries of York River State Park, the real and personal property within the boundaries of the York River State Park shall continue to be managed exclusively by the DCR. The use of York River State Park property within the boundaries of the Reserve shall be consistent with the purposes for which the Reserve is established, that is, preservation, research and education.

Reserve designation and execution of this Memorandum of Understanding between the VIMS and DCR will allow the VIMS to coordinate estuarine research and educational activities in the Reserve as a whole, in cooperation with the DCR personnel, according to the purposes for which the Reserve is established, and according to the final Management Plan as approved by NOAA. Further, by executing this Memorandum of Understanding the DCR acknowledges its commitment to long-term use of the Taskinas Creek reserve for resource management, research and education. This agreement shall not limit DCR authority to carry out Park activities and programs within the Reserve except as agreed to in this MOU.

The parties agree to coordinate fully their programs and activities conducted at the Reserve at Taskinas Creek. Disputes concerning such activities and programs shall be resolved at the appropriate level of management.

ARTICLE IV.-Reserve Facilities

The DCR will make available at no cost to the Reserve Program a reasonable portion of the Visitor Center at York River State Park for office space for educational personnel. The Visitor Center area may also be used for meetings and for storage of educational and research materials, supplies and equipment. If changes become necessary to the building or equipment to accommodate or facilitate these functions at a future date, it is agreed that the DCR and VIMS will develop a plan to implement those changes. It is understood that VIMS funds from the Federal financial award may be used for this purpose. Any use of U.S. Dept. of Commerce funds are subject to approval.

The DCR and VIMS may deem it necessary to jointly fund the improvements of other access to the Reserve and DCR facilities.

The DCR and VIMS will also work out arrangements for the use of existing nature trails and other facilities under the Reserve Program, and will jointly plan and pursue, if necessary, the creation of any new trails, boardwalks, exhibits, docks, parking areas, facilities, equipment, etc., that enhance the management, research, and education goals of the Reserve. It is understood that these additional facilities will be developed to preserve the environment in the area by concentrating administrative facilities and public access in appropriate locations. It is further understood that VIMS' Federal financial assistance award monies may be used for these purposes. Any U.S. Dept. of Commerce Reserve funds are subject to NOAA approval.

ARTICLE V.-NOAA's Condition of Financial Assistance

A copy of the financial award assistance No. from NOAA to VIMS, on behalf of the Commonwealth of Virginia, pursuant to CZMA, is appended hereto as Appendix C and fully incorporated herein by reference. The DCR is aware of the conditions and requirements placed on the Commonwealth of Virginia thereunder. The DCR agrees to cooperate in all respects with the VIMS in complying with the terms and conditions of the award. DCR will record the value of its contributions to the administration, maintenance, and operations of the Taskinas Creek Reserve. In particular, the DCR agrees to cooperate with the VIMS in meeting any audit, or other accounting requirements imposed by NOAA.

ARTICLE VI.- Operation and Maintenance of the Reserve Program

The DCR and VIMS shall meet annually, prior to March 1 of each calendar year, to prepare an operations plan, including an operating budget, for the Taskinas Creek Reserve site.

VIMS will apply for annual Operations Grants from NOAA to cover 50% of the cost of the operation and maintenance of the Reserve program at Taskinas Creek and the other Reserve sites (Goodwin Islands, Catlett Islands, Sweet Hall Marsh and other future sites). The remaining funds for operations and maintenance will come from the General Assembly as part of the VIMS biennial appropriations as well as from other public sources and private sources. These funds may include funds for facilities, equipment, and salaries. The funds will be apportioned among the Reserve sites on a "needs" priority basis.

ARTICLE VII.-Education and Research Monitoring Grants

Education

VIMS will apply for annual Education Grants from NOAA to cover 50% of the costs of (1) designing, developing, and distributing interpretive and educational media; (2) developing and presenting curricula, workshops, lectures, or seminars; and (3) developing internship programs to provide estuarine resource management learning opportunities for interested students. The remaining 50% of the costs will be sought from the General Assembly as part of the VIMS biennial appropriations. VIMS will also seek funding from sources other than federal and state funds; i.e., private donations, corporate gifts, or grants from industry. The DCR and VIMS will

meet annually to identify priority interpretive and education projects for which funding will be sought. The DCR and VIMS will solicit input from an Educational Advisory Committee (see Article XII).

Monitoring

VIMS will apply for annual competitive Phased Monitoring Grants from NOAA to cover 50% of the costs of (1) developing environmental characterizations of Reserve sites; (2) developing site profiles for Reserve sites; and (3) designing a monitoring program for Reserve sites. The VIMS will also seek the remaining 50% of the costs from state and private sources. The DCR and VIMS will meet on an annual basis to determine priority management issues that need to be addressed through a phased monitoring program. The DCR and VIMS will seek input from the Research and Monitoring Advisory Committee.

Research

VIMS will solicit proposals for annual Competitive Research Grants from NOAA to cover 50% of the costs of conducting research at Reserve sites. Applicants will have to provide state or private funds as match for the remaining 50% of the costs. The DCR and VIMS will meet on an annual basis to determine priority research needs for which proposals will be sought. The DCR and VIMS will seek input on priority research needs from the Research and Monitoring Advisory Committee.

VIMS will conduct a peer review process for research proposals received as a result of solicitation. The DCR and the Research and Monitoring Advisory Committee will provide review comments as part of this process and will assist VIMS in selecting proposals to forward to NOAA for approval. The DCR will provide a letter of support for proposals involving the Taskinas Creek Reserve.

Grants Administration

VIMS will assist the DCR in reviewing applications for permits for sponsored and unsponsored education, monitoring and research projects involving Taskinas Creek Reserve site. The DCR will forward copies of applicable permit applications to VIMS and will consider VIMS comments in determining whether to grant the permit. At least 2 weeks will be allowed for such review.

The DCR and VIMS will review reports prepared under education and research monitoring grants concerning the Taskinas Creek Reserve site. At least 2 weeks will be allowed for the review. Investigators will be required to deposit final reports with VIMS and the DCR. Copies of such reports shall be provided to the DCR for Park use. VIMS intends to publish outstanding reports as part of the Reserve or VIMS publication series.

ARTICLE VIII.-Administration of the Reserve

The DCR will have primary management responsibilities for day-to-day administration, operations, and maintenance of the Taskinas Creek component of the Reserve system in cooperation and consultation with VIMS. Other

cooperative projects between DCR and VIMS and other academic institutions or other organizations which are designed specifically to address Reserve goals of education, research and preservation shall also require cooperation and consultation.

DCR and VIMS further agree to cooperate on the following Reserve management functions:

a. DCR and VIMS will prepare an annual list of research, education, resource protection, and restoration needs for Taskinas Creek; VIMS will help seek funding to fulfill these identified needs;

b. DCR will enforce Park rules and regulations and reserve management policies within the Taskinas Creek Reserve site; VIMS will insure compliance among participants in VIMS sponsored activities within the reserves;

c. DCR will report to VIMS on the types, nature, and location of violations of Park rules and regulations and reserve management policies when they occur within the Taskinas Creek Reserve site; VIMS will be responsible for coordinating activities that are specifically related to education, monitoring, and research with the Taskinas Creek Reserve site in cooperation and consultation with DCR; prepare an annual summary of violations reported within the reserve site for incorporation into the annual report to NOAA; VIMS and DCR will consult on actions needed to address recurring management concerns;

d. DCR and VIMS will consult on plans and provide sites for displays, facilities, and extensions of facilities proposed for the Taskinas Creek Reserve site;

e. DCR will VIMS shared use of Park facilities and equipment, and VIMS will allow DCR shared use of Reserve facilities and equipment. Use of these facilities and equipment will not detract from original purposes for which they were developed or acquired;

f. DCR and VIMS will share financial and custodial responsibilities for maintenance, repair, security, and insurance of facilities constructed with NOAA and/or VIMS funds under the auspices of the Reserve program;

g. DCR and VIMS will provide technical advice, staff assistance, and funding as available for research, education, and resource protection activities at the Taskinas Creek Reserve site;

h. DCR will issue permits for approved research, education, and resource protection/restoration projects as required;

i. DCR and VIMS will solicit the support of neighboring property owners, non-profit organizations, civic groups, and county officials, for reserve program operations;

j. DCR and VIMS will cooperate in the design, training, and supervision of volunteer programs for the Taskinas Creek Reserve site;

k. DCR will involve VIMS in the review and update of the Park resource management plan and assist VIMS in the review and update of the Reserve management plan; and

l. DCR and VIMS will monitor the impact of visitor use and reserve activities and take steps to mitigate impacts.

ARTICLE IX -- Reserve Director

The Reserve Director, who is headquartered at VIMS, is responsible for the overall development and management of the Reserve program. Some of these programs may involve the use of the Taskinas Creek site and Park facilities, resources, trails, exhibit space, and personnel. The Reserve Director will involve DCR in the development of programs involving the Taskinas Creek site. The Reserve Director's specific responsibilities which will involve the Taskinas Creek site will include the following:

a. Submits an annual budget for NOAA funds for the Taskinas Creek site using input from the Planning and Evaluation Committee and oversees expenditures of these funds;

b. Provides recommendations and approval of programs and projects proposed for Taskinas Creek for NOAA funding;

c. Submits required reports to NOAA;

d. Supervises the Reserve program staff, including the Education Coordinator;

e. Serves as principal contact for the estuarine research reserve program and represents VIMS in public relations and media contacts regarding the reserves;

f. Makes presentations on behalf of VIMS and the Reserve program to local officials, environmental organizations, and other interested groups;

g. Monitors the progress of VIMS and NOAA sponsored programs and projects at Taskinas Creek;

h. Involves DCR in the development and update of the Reserve management plan;

i. Coordinates the development and implementation of research, education, and resource protection priorities for Taskinas Creek sites with relevant activities of DCR and other state agencies, the Chesapeake Bay Program, Virginia Coastal Resources Management Program, Virginia River Basin Committees, The Nature Conservancy, Chesapeake Bay Foundation, and other relevant groups;

j. Drafts conservation easements and management agreements on behalf of VIMS for Reserve sites and negotiates terms and conditions;

k. Works with DCR to develop resource protection guidelines and policies for reserve sites as new issues arise;

ARTICLE X-Education Coordinator

VIMS will hire an education coordinator to develop and implement education programs for the Reserve program. Some of these education programs may involve use of the Taskinas Creek site and Park facilities, resources, trails, exhibit space, and personnel. The education coordinator will involve DCR in the development of education programs involving the Taskinas Creek Reserve site. The DCR will approve education programs prior to implementation. While the education coordinator is primarily responsible for education programs on behalf of VIMS and the Reserve program, it should be recognized that these activities will complement Park public environmental education and interpretive responsibilities under DCR programs. VIMS and DCR will encourage a cooperative working arrangement between the education coordinator and the Park, thereby maximizing the range of education programs that can be provided.

ARTICLE XI-Reserve Management Plan

A Management Plan for the Reserve Program has been developed by VIMS, in consultation with DCR, and will be submitted to NOAA for approval. Activities at the Taskinas Creek Reserve site will be conducted in a manner which is consistent with the Reserve Management Plan and Park Resource Management Plan. Under the terms of this agreement, the DCR will continue to fund, operate and administer its lands and facilities at York River State Park, and will continue to conduct its activities and programs pursuant to its mandate, except as agreed in this MOU. This agreement shall not limit DCR authority to carry out such activities so long as they do not adversely affect implementation of the Reserve Management Plan.

This Memorandum of Understanding shall go into full effect when the Reserve Management Plan is agreed to by the parties in writing and approved by NOAA. Revisions to the Reserve Management Plan shall only be made by written agreement of the parties and upon approval by NOAA.

ARTICLE XII-Advisory Committees

There will be established a Planning and Evaluation Committee to develop the operations plan, including an operating budget, as well as to evaluate annual accomplishments. The Dean/Director of VIMS and the DCR Director will appoint appropriate staff experts to this committee.

In addition to Reserve program staff, the following advisory committees will be established to advise in the management of the Reserves and to make appropriate recommendations to the Planning and Evaluation Committee:

Resource Protection and Management Committee
Education Committee
Research and Monitoring Committee

The responsibilities of each committee are outlined in the Reserve Management Plan. The DCR Director will appoint a DCR staff expert to each of the committees. The Superintendent of York River State Park will

continue to be the principal contact for VIMS matters pertaining to the day-to-day operations of the Park.

ARTICLE XIII-Termination of the MOU

This MOU shall be in effect for a period of five years from the date of its approval and shall be renewable for additional five year periods if such is mutually agreeable.

If VIMS ceases to operate the Reserve at Taskinas Creek as a designated Reserve, or Reserve designation is withdrawn or otherwise terminated, this MOU and the VIMS' interest shall be terminated and the DCR shall again have the full and exclusive control of the property.

For the purposes of this Article, the parties agree that a decision to terminate this Agreement shall be made jointly by the parties, with one year's advance notice given.

IN WITNESS WHEREOF, the parties hereto have caused this Memorandum of Understanding to be executed on this date July 13, 1990.

Patricia S. Greenwood
WITNESS

B.C. Leynes, Jr.
B.C. Leynes, Jr., Director
Department of Conservation
and Conservation

Paul W. Koch
WITNESS

Frank O. Perkins
Frank O. Perkins, Director
Virginia Institute of Marine
Science, College of William
and Mary

Conservation Easement

Catlett Island National Estuarine Research Reserve in Virginia

THIS CONSERVATION EASEMENT, made this 5 day of September, 1990 by and between John W. C. Catlett and William E. Catlett, hereinafter called the Grantors, and The College of William and Mary in Virginia, hereinafter called the Grantee.

WITNESSETH

WHEREAS, the Grantors are owners in fee simple of certain real property (hereinafter described and referred to as the "Catlett Islands"), situated in the County of Gloucester, Commonwealth of Virginia, being more particularly described as "forested islands and marshes extending from mean low tide to the wetland/upland border where the marsh meets the treeline on the landward side of the islands" as shown in Exhibit A and described in Exhibit B, attached hereto and incorporated by reference herein; and

WHEREAS, the Catlett Islands have substantial wetlands and forest resources and significant ecological, natural, research, educational, and aesthetic values, which this Conservation Easement will help to preserve and maintain, including the ability to protect water quality and important aquatic resources and habitats of the York River; and

WHEREAS, the specific ecological, natural, research, educational, and aesthetic values of the Catlett Islands are documented in the ecological survey made by the Virginia Institute of Marine Science (VIMS) on behalf of the Grantee and dated August 31, 1990 (Exhibit C), which will serve as an information base for monitoring and enforcement purposes and will be kept current by VIMS; and

WHEREAS, this Conservation Easement is being made with the intention and understanding of both the Grantors and Grantee that the property subject to this easement will be designated as part of the Chesapeake Bay National Estuarine Research Reserve System in Virginia and the National Estuarine Research Reserve System; and

WHEREAS, the Grantors desire and intend that the ecological, natural, research, educational, and aesthetic values of the Catlett Islands shall be preserved and maintained by restricting and limiting the use of the land and contiguous water areas of their property, on the terms and conditions and for the purposes hereinafter set forth, and the Grantee is willing to accept responsibility for managing the property for the purpose of conducting basic scientific and applied research and providing timely and accurate information to the Grantors and the citizens of the Commonwealth regarding the quality and conservation of the resources, both living and non-living, of the Catlett Islands, on the terms and conditions and for the purposes hereinafter set forth;

33. Notification - The Grantors agree to notify the Grantee, in writing, before exercising any reserved right the exercise of which may have an adverse impact on the conservation interests associated with the Catlett Islands. Any notices by the Grantors to the Grantee pursuant to any provision hereof shall be sent by registered or certified mail, return receipt requested, addressed to Mr. John W.C. Catlett and Mr. William E. Catlett, P.O. Box 148, Wicomico, Virginia 23184.

IN WITNESS WHEREOF, the Grantors and Grantee have hereunto set their hands and seals the day and year above written.

State of Virginia
County of Gloucester, to-wit:

The foregoing instrument was acknowledged before me this 5th day of September 1990 by John W. C. Catlett, Jr. and William E. Catlett.

Susan W Carter
Notary Public
My commission expires: 8/31/93.

Grantors:

John W.C. Catlett, Jr. (SEAL)

William E. Catlett (SEAL)

ACCEPTED BY

_____

AS GRANTEE:

_____(SEAL)

APPROVAL AS TO FORM:

Assistant Attorney General for the
Attorney General of Virginia

RECOMMEND:

Director
Division of Engineering and Buildings

RECOMMEND:

Director
Department of General Services

APPROVED FOR THE GOVERNOR:

Pursuant to the provisions of Section 2.1-504.2, Code of Virginia (1950), as amended, and by authority of Executive Order 78 (89), I hereby approve the acquisition of this conservation easement from John W. C. Catlett, Jr. and William E. Catlett, which is more fully described herein, and the execution of this document.

Secretary of Administration,
for the Governor of Virginia

10-02-90
Date

VIMS0912aHGD

Conservation Easement

Catlett Island National Estuarine Research Reserve
in Virginia

THIS CONSERVATION EASEMENT, made this 14 day of November, 1990 by and between John W. C. Catlett, Jr., Charles Catlett, and Mary Armistead Catlett Burruss, hereinafter called the Grantors, and The College of William and Mary in Virginia, hereinafter called the Grantee.

WITNESSETH

WHEREAS, the Grantors are owners in fee simple of certain real property (hereinafter described and referred to as the "Catlett Islands"), situated in the County of Gloucester, Commonwealth of Virginia, being more particularly described as "forested islands and marshes extending from mean low tide to the wetland/upland border where the marsh meets the treeline on the landward side of the islands" as shown in Exhibit A and described in Exhibit B, attached hereto and incorporated by reference herein; and

WHEREAS, the Catlett Islands have substantial wetlands and forest resources and significant ecological, natural, research, educational, and aesthetic values, which this Conservation Easement will help to preserve and maintain, including the ability to protect water quality and important aquatic resources and habitats of the York River; and

WHEREAS, the specific ecological, natural, research, educational, and aesthetic values of the Catlett Islands are documented in the ecological survey made by the Virginia Institute of Marine Science (VIMS) on behalf of the Grantee and dated August 31, 1990 (Exhibit C), which will serve as an information base for monitoring and enforcement purposes and will be kept current by VIMS; and

WHEREAS, this Conservation Easement is being made with the intention and understanding of both the Grantors and Grantee that the property subject to this easement will be designated as part of the Chesapeake Bay National Estuarine Research Reserve System in Virginia and the National Estuarine Research Reserve System; and

WHEREAS, the Grantors desire and intend that the ecological, natural, research, educational, and aesthetic values of the Catlett Islands shall be preserved and maintained by restricting and limiting the use of the land and contiguous water areas of their property, on the terms and conditions and for the purposes hereinafter set forth, and the Grantee is willing to accept responsibility for managing the property for the purpose of conducting basic scientific and applied research and providing timely and accurate information to the Grantors and the citizens of the Commonwealth regarding the quality and conservation of the resources, both living and non-living, of the Catlett Islands, on the terms and conditions and for the purposes hereinafter set forth;

NOW THEREFORE, as an absolute gift of no monetary consideration ($0.00) but in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, the Grantors hereby grant and convey to the Grantee, its successors, and assigns forever and in perpetuity a Conservation Easement in Gross ("Conservation Easement") for the purpose of research, observation, and education and to the extent hereinafter set forth with respect to the Catlett Islands.

To achieve these objectives, the following conditions and restrictions are set forth:

ARTICLE I. DURATION AND GENERAL PURPOSE

1. General Purpose - The purpose of this Conservation Easement is to preserve and protect the environment of the Catlett Islands and to maintain permanently its natural and cultural values and its dominant scenic, rural, woodland, and wetland character so that the property remains suitable for long-term research on natural and human processes occurring within the York River tributary of the Chesapeake Bay. The Grantors and Grantee intend to confine the use of the property to such activities, including, without limitations, those involving hunting, trapping, fishing, gathering oysters, naturalistic uses, and estuarine reserve research purposes.

2. Duration - This Conservation Easement shall be perpetual. The covenants agreed to and the terms, conditions, restrictions and purposes imposed with this Conservation Easement shall not only be binding on the Grantors but also their agents, personal representatives, heirs and assigns and all other successors to their interests and shall continue as a servitude running in perpetuity with the Catlett Islands.

ARTICLE II. MANAGEMENT OBJECTIVES

3. Management Plan Preparation and Implementation - There shall be a Management Plan prepared for the Catlett Islands to provide general guidelines for the current and future use of the property. The Management Plan shall address appropriate wetlands and forest management activities, wildlife and waterfowl needs, and research and education uses of the Catlett Islands, and it shall provide any other applicable guidelines for the conservation of natural resources.

The Management Plan shall be prepared by VIMS, in consultation with other resource management agencies of the Commonwealth, and shall be submitted to be the Grantors and Grantee for their review and approval, within 6 months of the execution of this Conservation Easement. The Grantors and Grantee shall meet at least annually, and more frequently at the request of either party, to review the Management Plan and research results and, where appropriate, to develop more specific recommendations for carrying out certain aspects of the Plan. The Management Plan shall be updated at least every 5 years.

4. On-Site Management - VIMS is the agency designated by the Grantee and the Governor of the Commonwealth of Virginia to manage the Chesapeake Bay National Estuarine Research Reserve System in Virginia. In this capacity, VIMS shall serve as on-site manager for research at the Catlett Islands and shall be responsible for seeing that research conducted on the property is conducted in a manner consistent with the goals of the Chesapeake Bay National Estuarine Research Reserve System in Virginia, the objectives of the Management Plan, and the wishes of the Grantors and Grantee. The on-site manager will be the Grantee's primary representative for the purpose of monitoring the uses of the property for consistency with this Conservation Easement.

5. Natural Area Preservation - The Catlett Islands shall be maintained as open space, wildlife and waterfowl habitat, and a natural field laboratory for research and education. Any industrial or commercial activities shall be prohibited on the Catlett Islands. The protection and conservation of the land subject to this Conservation Easement will be maintained and enforced consistent with the goals and policies of the Chesapeake Bay National Estuarine Research Reserve System in Virginia.

6. Research and Education - The Catlett Islands shall be maintained for research and education activities associated with the Chesapeake Bay National Estuarine Research Reserve System in Virginia. Research and education uses of the Catlett Islands shall be in accordance with the principles, objectives, and performance standards set forth in the Management Plan developed by VIMS and approved by the Grantors and Grantee. A steering committee will be convened by VIMS to assist in the review and approval of proposals for research and education activities at reserve sites. Such approval shall not be unreasonably withheld.

7. Information Exchange - Research and education activities conducted at the Catlett Islands shall be used to enhance awareness, understanding, and wise use of estuarine environments. VIMS shall provide the Grantors and Grantee with an annual report on research and education activities conducted on the Catlett Islands and shall disseminate timely and accurate information to the Governor, General Assembly, State and local agencies, industry, and citizens of the Commonwealth regarding the living and non-living resources of the Catlett Islands and their relationship to the Chesapeake Bay system and the coastal waters of the Commonwealth of Virginia.

ARTICLE III. CONTROLLED ACTIVITIES

8. Wetlands and Forest Maintenance - Wetlands shall be protected and maintained in accordance with the Management Plan and the Wetland Guidelines developed pursuant to Chapter 2.1 of Title 62.1 of the Code of Virginia. Forest management activities shall be conducted in accordance with the Management Plan and Best Management Practices promulgated by the Commonwealth of Virginia, Division of Forestry, and recommended by the U.S. Department of Agriculture, Forest Service and Soil Conservation Service. There shall be no other destruction or alteration of wetlands or forests on

the Catlett Islands, except as needed to eradicate noxious plant species or reestablish native plant species and as approved by the Grantors and Grantee. Management activities shall not materially impair the scenic quality of the Catlett Islands.

9. Waterfowl and Wildlife Maintenance - Waterfowl and wildlife maintenance activities shall be conducted in accordance with the Management Plan. In general, such activities shall be limited, where necessary, to maintenance of existing habitat and minor improvements (such as tree thinning to improve understory vegetation, or opening of small areas to provide a greater diversity of habitats) and as approved by the Grantors and Grantee. Any waterfowl and wildlife management activities shall be carried out under the guidance of the Commonwealth of Virginia, Department of Game and Inland Fisheries and the U.S. Department of the Interior, Fish and Wildlife Service. Any plant and insect management activities that may affect species of plants or insects protected under the Virginia Endangered Plant and Insect Species Act shall be carried out under the guidance of the Virginia Department of Agriculture and Consumer Services.

10. Hunting and Fishing - Any hunting shall be carried out in designated areas on and around the Catlett Islands and in accordance with conditions established in the Management Plan and approved by the Grantors and Grantee, and in accordance with rules and regulations promulgated by the Commonwealth of Virginia, Department of Game and Inland Fisheries. The Grantors, or their assigns, may place noncommercial blinds on the Catlett Islands for personal use. Any fishing shall be carried out in accordance with regulations promulgated by the Virginia Marine Resources Commission.

11. Water Quality - There shall be no human activities on or uses of the Catlett Islands that are detrimental or adverse to the maintenance and conservation of surface and subsurface water quality. There shall be no manipulation or alteration of natural water courses, shorelines, marshes or other water bodies, nor shall there be activities conducted on or around the Catlett Islands that could alter either natural water level, flow, or both.

12. Structures, Roads, and Trails - Except as otherwise provided in this Conservation Easement, no new buildings, facilities, structures, piers, roads, or trails shall be constructed on the Catlett Islands, except those designed, constructed and utilized in, and accessary to, research, education, hunting, and naturalistic uses of the property. Any such construction must be planned for in the Management Plan and approved by the Grantors and Grantee. Similarly, removal of existing structures must be planned for in the Management Plan and approved by the Grantors and Grantee. There shall be no compulsion to remove existing structures.

13. Signs and Billboards - Display of billboards, signs or other advertisements is not permitted on or over the Catlett Islands, except to state the name and/or address of the owner, to provide notice of designation as a Chesapeake Bay National Estuarine Research Reserve in Virginia, and/or to post the property against trespass.

14. Subdivision - The Catlett Islands shall not be partitioned or subdivided.

15. Excavation, Dredging, and Mining - Excavation, dredging, mining and removal of loam, gravel, soil, rock, sand, coal, petroleum and other materials on or below ground or alteration of the topography of the land is prohibited on the Catlett Islands, except as related to the collection of geological data. Such activities shall be planned for in the Management Plan and approved by the Grantors and Grantee.

16. Industrial and Commercial Activities - No industrial or commercial activities shall be conducted on the Catlett Islands.

17. Trash, Rubbish, and Waste - There shall be no dumping of soil, trash, ashes, garbage, waste, or offensive materials on the Catlett Islands. There shall be no filling in of any wetland, pond or waterway, and such dumping shall be absolutely prohibited. Neither the Grantors nor the Grantee shall be responsible for unauthorized dumping.

18. Off Road Vehicles - Neither the Grantors or the Grantee shall authorize the operation of motor vehicles, trail bikes or all-terrain vehicles on the Catlett Islands, and such use shall be prohibited. The Grantors shall not be responsible for unauthorized use.

ARTICLE IV. ENFORCEMENT AND REMEDIES

19. Injunctive Relief and Restoration - Upon any breach of the terms of this Conservation Easement by the Grantors, their successors or assigns, or the Grantee, its successors or assigns, the breaching party may be subject to suit to: (1) enjoin any breach or enforce any covenant by temporary restraining order, preliminary and/or permanent injunction; (2) require that the property be restored promptly to the condition required by this Conservation Easement; or (3) seek any other remedy available, in law or equity, to assure compliance with the terms of this Conservation Easement.

20. Perpetual Right of Enforcement - Failure on the part of the Grantee to enforce any covenant or provision hereof shall not discharge or invalidate such covenant, or any other covenant, condition, or provision hereof, or affect the right of the Grantee to enforce the same in the event of a subsequent breach or default.

ARTICLE V. GRANTORS' RIGHTS

21. Grantors' Rights - The Grantors expressly reserve to themselves, their personal representatives, heirs, successors or assigns the right to:

a. Continue the naturalistic uses of the Catlett Islands subject to the conditions set forth above;

b. Continue to hunt, fish, trap, and gather oysters on and around the Catlett Islands subject to applicable laws;

c. Improve, repair, restore, alter, remove, remodel, or replace permitted structures, provided that such activity is consistent with the Management Plan; and

d. Continue the use of the Catlett Islands for all purposes consistent with this Conservation Easement.

ARTICLE VI. RIGHTS OF GRANTEE

22. Rights of Grantee - To accomplish the purpose of this Conservation Easement, the following rights are conveyed to the Grantee by this Conservation Easement:

a. To preserve and protect the conservation values of the Catlett Islands;

b. To enter upon the Catlett Islands at reasonable times in order to conduct approved research and educational projects and to monitor Grantors' compliance with and otherwise enforce the terms of this Conservation Easement; provided that such entry shall be upon prior reasonable notice to Grantors, such entry shall be by water, and shall not unreasonably interfere with Grantors' use and quiet enjoyment of the Catlett Islands;

c. To give permission to research scientists to conduct research and educational projects approved for the Catlett Islands National Estuarine Research Reserve, provided that permittees carry and display an official permit issued by the Grantee and approved by the Grantors; and

d. To prevent any activities or use of the Catlett Islands that is inconsistent with the purposes of this Conservation Easement and to require the restoration of such areas or features of the Catlett Islands that may be damaged by any inconsistent activity or use.

ARTICLE VII. GRANTORS' AND GRANTEE'S LIABILITY

23. Upkeep by Grantors - The Grantors, their successors, and assigns further agree that they shall be responsible for upkeep of the Catlett Islands and shall hold the Grantee, its successors or assigns, harmless from any charges or liens arising out of upkeep or taxes.

24. Taxes - The Grantor agrees to pay any and all real property taxes and assessments levied by competent authority on the property.

25. Grantors' Liability - The Grantors, their successors, and assigns shall not be held responsible for injury to persons or damages to property arising out of any research or educational activity being conducted on the Catlett Islands pursuant to the Management Plan and this management agreement, except those arising out of the negligence of the Grantors, their successors, and assigns. All persons participating in research or educational activities at the Catlett Islands must sign a liability release form indemnifying and holding harmless the Grantors, their agents and guests, from any and all liability, claims, or expenses for injury, death or damages to self or property, including without limitation attorney's fees, resulting from or arising out of or in anyway relating to the activities of the Grantee, any of its representatives, agents or guests, or resulting from, or occurring in the course of transit to or from the Catlett Islands. A copy of the release form appears as Exhibit D.

The Grantee has inspected the Catlett Islands and accepts their condition "as is" as described in Exhibit C. Any existing conditions or future conditions relating to permitted uses of the Catlett Islands by the Grantors, including, without limitation, any hunting and fishing activities, shall not constitute conditions giving rise to a claim of negligence on the part of the Grantors or to any potential liability for damage to property or injury to person. The Grantors' liability for all other activities on the Catlett Islands shall remain in effect.

26. Grantee's Liability - The Commonwealth of Virginia and all its agencies and institutions are covered by a self-insurance program as authorized by Section 2.1-526.8 of the Code of Virginia which is based upon a comprehensive general liability manuscript policy form as shown in Exhibit E. All persons who are not employees of the Commonwealth must receive approval from the Grantors and furnish evidence of liability coverage in the amount of $100,000/$300,000/$100,000 before participating in research or education activities at the Catlett Islands. All persons, whether employees of the Commonwealth or not, shall sign a liability release form referenced in paragraph 25 and appearing in Exhibit D.

ARTICLE VIII. PUBLIC ACCESS

27. Public Access - The granting of this Conservation Easement does not grant to the public any right to enter the property. The Grantee's right of entry does not include access to the interior of buildings or structures. All other protections against trespass by the public shall remain in effect.

ARTICLE IX. MISCELLANEOUS

28. Assignment, Transfer, and Reversion - The Grantee may assign its rights under this Conservation Easement to the Virginia Institute of Marine Science in such manner as to achieve the purposes and conditions herein. If any such assignee shall cease to exist or abandon this Conservation Easement or the rights and duties of enforcement herein set forth, or if proceedings

are instituted for condemnation of this Conservation Easement, the easement and rights of enforcement shall revert to the Grantee. If the Grantee shall be dissolved and if the terms of the dissolution fail to provide a successor, then the Court shall appoint an appropriate successor as Grantee.

The Grantors agree for themselves, their personal representatives, heirs, successors, and assigns to send in writing to the Grantee the names and addresses of any party to whom the Catlett Islands is to be transferred at the time said transfer is executed. The Grantee agrees to hold this Conservation Easement exclusively for conservation purposes, and that it will not transfer the Conservation Easement in exchange for money, other property, or services. This provision shall not preclude the Grantee from using the monetary value of any donations or gifts from the Grantor as match for money, other property, or services that will contribute to fulfilling the objectives of the Management Plan or the terms of this Conservation Easement.

29. Relationship of Easement to Property Value - The Grantors and the Grantee agree that the donation of the Conservation Easement gives rise for purposes of this paragraph to a property right, immediately vested in the Grantee with a fair market value that is at least equal to the proportionate value that the Conservation Easement bears to the value of the Catlett Islands at the time of the gift.

30. Eminent Domain - Whenever all or part of the Catlett Islands are taken in the exercise of eminent domain and such taking abrogates the restrictions imposed by this Conservation Easement, the Grantors and the Grantee shall join in appropriate actions at the time of such taking to recover the full value of the taking and all incidental or direct damages resulting from the taking. All expenses incurred by the Grantors and the Grantee in this action shall be paid out of the recovered proceeds.

31. Inclusion of Terms in Subsequent Deeds - The Grantors agree that the terms, conditions, restrictions and purposes of this grant will be inserted by them in any subsequent deed or other legal instrument by which the Grantors divest themselves of any interest in the Catlett Islands.

32. Construction and Severability - It is the intention of the parties hereto that this Conservation Easement, which is by nature and character negative in that the Grantors have restricted and limited their right to use the the Catlett Islands rather than granted any affirmative rights to the Grantee except as otherwise set forth herein, be construed at all times and by all parties to effectuate its terms, conditions and purposes. If any provision of this Conservation Easement or the application thereof to any person or circumstance is found to be invalid, the remainder of the provisions of the Conservation Easement and the application of such provisions to persons or circumstances other than those as to which it is found to be invalid shall not be affected thereby.

33. Notification - The Grantors agree to notify the Grantee, in writing, before exercising any reserved right the exercise of which may have an adverse impact on the conservation interests associated with the Catlett Islands. Any notices by the Grantors to the Grantee pursuant to any provision hereof shall be sent by registered or certified mail, return receipt requested addressed to Mr. John W.C. Catlett, P.O. Box 148, Wicomico, Virginia 23184.

IN WITNESS WHEREOF, the Grantors and Grantee have hereunto set their hands and seals the day and year above written.

Grantors:

State of Virginia
County of Gloucester, to-wit:

The foregoing instrument was acknowledged before me by Charles Catlett this 14th day of November, 1990.

Charles Catlett (SEAL)

14 November 1990 (DATE)

Susan W. Carter

Notary Public

My commission expires: August 31, 1993.

State of Virginia
County of Gloucester, to-wit:

The foregoing instrument was acknowledged before me by Mary A. C. Burruss this 14th day of November, 1990.

Mary A. C. Burruss (SEAL)

14 November 1990 (DATE)

Susan W. Carter

Notary Public

My commission expires: August 31, 1993.

State of Virginia
County of Gloucester, to-wit:

The foregoing instrument was acknowledged before me by John W. C. Catlett, Jr. this 19th day of November, 1990.

John W.C. Catlett, Jr. (SEAL)

19 November 1990 (DATE)

Susan W. Carter

Notary Public

My commission expires: August 31, 1993.

ACCEPTED BY

AS GRANTEE:

Paul R. Verkuil (SEAL)

2-5-91 (DATE)

The foregoing instrument was
acknowledged before me by
Paul R. Verkuil this 5th day
of February, 1991.

Mary D Anderson

Notary Public

My commission expires: May 31, 1993

State of Virginia
City of Williamsburg, to-wit

~~APPROVAL AS TO FORM:~~

Assistant Attorney General for the

~~Attorney General of Virginia~~

RECOMMEND:

Director

Division of Engineering and Buildings

RECOMMEND:

Director

Department of General Services

APPROVED FOR THE GOVERNOR:

Pursuant to the provisions of Section 2.1-504.2, Code of Virginia (1950), as amended, and by authority of Executive Order 78 (89), I hereby approve acquisition of this conservation easement from John W.C. Catlett, Jr., Charles Catlett, and Mary Armistead Catlett Burruss, which is more fully described herein, and the execution of this document.

Ruby G. Martin

Secretary of Administration,

for the Governor of Virginia

12-18-90

Date

Management Agreement

Tick Hill Component
of the
Sweet Hall Marsh National Estuarine Research Reserve
in Virginia

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Management Agreement

Tick Hill Component
of the
Sweet Hall Marsh National Estuarine Research Reserve
in Virginia

THIS MANAGEMENT AGREEMENT, made this __ day of _____, 1990 by and between Chesapeake Corporation, hereinafter called the Grantor, and The College of William and Mary in Virginia, hereinafter called the Grantee.

WITNESSETH

WHEREAS, the Grantor is owner in fee simple of certain real property (hereinafter described and referred to as "Tick Hill"), situated in the County of King William, Commonwealth of Virginia, being more particularly delineated as "freshwater tidal wetlands extending from mean low tide on the Pamunkey River to 100 feet inland from the wetland/upland border landward of the Pamunkey River as shown in Exhibit A described in Exhibit B, attached hereto and incorporated by reference herein; and

WHEREAS, Tick Hill is a managed woodland and marsh which has substantial wetlands and forest resources and significant ecological, natural, research, educational, and aesthetic values, which this contract will help to preserve and maintain, including the ability to protect water quality and important aquatic resources and habitats of the Pamunkey River, a tributary of the York River; and

WHEREAS, the Virginia Institute of Marine Science (VIMS), within the College of William and Mary, has been designated by the Governor of the Commonwealth of Virginia to develop and manage the Chesapeake Bay National Estuarine Research Reserve System in Virginia; and

WHEREAS, this Management Agreement is being made with the intention and understanding of both the Grantor and Grantee that the subject property will be designated as a component of the Chesapeake Bay National Estuarine Research Reserve System in Virginia, pursuant to Section 315 of the Coastal Zone Management Act of 1972, as amended (P.L. 92-583, 16 U.S.C. 1461), and implementing regulations (15 CFR 921.30); and

WHEREAS, the Grantor desires and intends that the ecological, research, and educational values of Tick Hill shall be preserved and maintained by restricting and limiting the use of the land and contiguous water areas of their property, to the degree possible under the woodlands management of the Grantor and on the terms and conditions and for the purposes hereinafter set forth, and the Grantee is willing to accept responsibility for managing the property for the purpose of conducting basic scientific and

applied research and providing timely and accurate information to the Grantor and citizens of the Commonwealth regarding the quality and conservation of the resources, both living and non-living, of Tick Hill, on the terms and conditions and for the purposes hereinafter set forth;

WHEREAS, the specific ecological, natural, research, educational, and aesthetic values of Tick Hill are documented in the ecological survey made by VIMS on behalf of the Grantee and dated August 31, 1990 (Exhibit B), which will serve as an information base for monitoring and enforcement purposes and will be kept current by VIMS; and

NOW THEREFORE, in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, the Grantor hereby conveys to the Grantee access to Tick Hill for the purpose of research, observation, and education to the extent hereinafter set forth.

To achieve these objectives, the following conditions and restrictions are set forth:

ARTICLE I. DURATION AND GENERAL PURPOSE

1. General Purpose - The purpose of this Management Agreement is to protect the environment of Tick Hill and to maintain its dominant rural, woodland, and wetland character so that Tick Hill remains suitable for long-term research on natural and human processes occurring within the watersheds and tributaries of the Chesapeake Bay. The Grantor and Grantee intend to confine use of the property to such activities, including, without limitations, those involving hunting, trapping, fishing, naturalistic uses, research, and timber management.

2. Duration - This Management Agreement shall be valid for a 5-year period, and the terms, conditions, restrictions and purposes imposed with this Management Agreement shall not only be binding on the Grantor but also its agents, personal representatives, heirs and assigns and all other successors to their interests for the duration of the Management Agreement, subject to the agreed upon termination provisions. This Management Agreement may be renegotiated at the end of the 5-year period at the discretion of both parties.

ARTICLE II. MANAGEMENT OBJECTIVES

3. Management Plan Preparation and Implementation - There shall be a Management Plan prepared for Tick Hill to provide general guidelines for the current and future use of the property. The Management Plan shall address wetlands and forest management activities, wildlife and waterfowl needs, and research and education uses of Tick Hill, and it shall provide any other applicable guidelines for conservation of natural resources.

The Management Plan shall be prepared by VIMS, in consultation with the Grantor and appropriate resource management agencies of the Commonwealth, and shall be submitted to the Grantor and Grantee for their review and approval, within 120 days of the execution of this Management Agreement. The Grantor and Grantee shall meet at least annually, and more frequently at the request of either party, to review the Management Plan and, where appropriate, to develop more specific recommendations for carrying out certain aspects of the Plan. The Management Plan shall be jointly updated at least every 5 years.

4. On-Site Management - VIMS is the agency designated by the Grantee and the Governor of the Commonwealth of Virginia to manage the Chesapeake Bay National Estuarine Research Reserve System in Virginia. In this capacity, VIMS will serve as on-site manager for research at Tick Hill and will be responsible for seeing that research conducted on the property is conducted in a manner consistent with the goals of the National Estuarine Research Reserve Program, the objectives of the Management Plan, and the wishes of the Grantor and Grantee. The on-site manager will be the Grantee's primary representative for the purpose of monitering uses of the property for consistency with this Management Agreement.

5. Natural Area Preservation - Tick Hill shall be maintained as open space, wildlife and waterfowl habitat, and a natural field laboratory for research, consistent with the woodlands management of the Grantor. The protection and conservation of the land subject to this Management Agreement will be maintained and enforced consistent with the goals and policies of the Chesapeake Bay National Estuarine Research Reserve System in Virginia.

6. Research and Education - Tick Hill shall be used for research and education activities associated with the Chesapeake Bay National Estuarine Research reserve System in Virginia. Research and education uses of Tick Hill shall be in accordance with the principles, objectives, and performance standards set forth in the Management Plan developed by VIMS and approved by the Grantor and Grantee. A steering committee shall be convened by VIMS to assist in the review and approval of proposals for research and education activities on Tick Hill. Approval of proposals and activities shall be approved by the Grantor, which approval shall not be unreasonably withheld.

7. Information Exchange - Research and education activities conducted at Tick Hill shall be used to enhance awareness, understanding, and wise use of estuarine environments. VIMS shall provide the Grantor and Grantee with an annual report on research and education activities conducted on Tick Hill and shall disseminate timely and accurate information to the Governor, General Assembly, State and local agencies, industry, and citizens of the Commonwealth regarding the living and non-living resources of Tick Hill and their relationship to the Chesapeake Bay system and the coastal waters of the Commonwealth of Virginia.

ARTICLE III. CONTROLLED ACTIVITIES

8. Wetlands and Forest Maintenance - Wetlands shall be protected and maintained in accordance with the Management Plan and the Wetland Guidelines developed pursuant to Chapter 2.1 of Title 62.1 of the Code of Virginia. Forest management activities shall be conducted in accordance with the woodlands management of the Grantor and Best Management Practices promulgated by the Commonwealth of Virginia, Department of Forestry.

9. Waterfowl and Wildlife Maintenance - Waterfowl and wildlife maintenance activities shall be conducted in accordance with the Management Plan. In general, such activities shall be limited to maintenance of existing habitat and minor improvements, where necessary (such as tree thinning to improve understory vegetation, or opening of small areas to provide a greater diversity of habitats), and as approved by the Grantor and Grantee. Any waterfowl and wildlife management activities shall be carried out under the guidance of the Commonwealth of Virginia, Department of Game and Inland Fisheries and the U.S. Department of the Interior, Fish and Wildlife Service. Any plant and insect management activities that may affect species of plants or insects protected under the Virginia Endangered Plant and Insect Species Act shall be carried out under the guidance of the Virginia Department of Agriculture and Consumer Services.

10. Hunting and Fishing - The Grantor may persue such hunting and fishing activities as it may elect as long as such activities are in compliance with applicable state or federal law.

11. Water Quality - There shall be no human activities on or uses of Tick Hill that are detrimental or adverse to the maintenance and conservation of surface and subsurface water quality. There shall be no manipulation or alteration of natural water courses, shorelines, marshes or other water bodies, nor shall there be activities conducted on or around Tick Hill that could alter either natural water level, flow, or both.

12. Structures, Roads, and Trails - There shall be no new buildings, facilities, structures, piers, roads, or trails constructed on Tick Hill, except those designed, constructed and utilized in and accessary to the research, education, forest management, wildlife management, and naturalistic uses of the property. Any such construction must be planned for in the Management Plan, and approved by the Grantor and Grantee. Similarly, removal of existing structures must be planned for in the Management Plan and approved by the Grantor and Grantee.

13. Signs and Billboards - Display of billboards, signs or other advertisements is not permitted on or over Tick Hill except to state the name and/or address of the owner, to provide notice of the designation as a Chesapeake Bay National Estuarine Research Reserve and/or to post the

property against trespass. No such sign shall exceed four feet by four feet in size.

14. Subdivision - Tick Hill shall not be partitioned or subdivided during the life of this Management Agreement.

15. Excavation, Dredging, and Mining - Excavation, dredging, mining and removal of loam, gravel, soil, rock, sand, coal, petroleum and other materials or alteration of the topography of the land is prohibited on Tick Hill except as related to the collection of geological data. Such activities shall be planned for in the Management Plan and approved by the Grantor and Grantee.

16. Industrial and Commercial Activities - No industrial or commercial activities shall be conducted on Tick Hill, except for timber harvest, site preparation, planting, and related silvicultural activities prescribed in the woodlands management of the Grantor. The Grantor shall give the Grantee 120 days prior written notice of when and where such activites will commence, so that the Grantee can monitor the activity, as planned for in the Management Plan and approved by the Grantor and Grantee.

17. Trash, Rubbish, and Waste - Neither the Grantor or the Grantee shall authorize dumping of soil, trash, ashes, garbage, waste, or offensive materials on Tick Hill or filling in of any wetland, pond or waterway. Neither the Grantor or the Grantee shall be held responsible for unauthorized dumping.

18. Off Road Vehicles - Neither the Grantor or the Grantee shall authorize operation of motor vehicles, trail bikes or all-terrain vehicles on Tick Hill, except as related to timber management and hunting activities approved by the Grantor. Neither the Grantor or the Grantee shall be held responsible for unauthorized use.

ARTICLE IV. ENFORCEMENT AND REMEDIES

19. Injunctive Relief and Restoration - Upon any breach of the terms of this Management Agreement by the Grantor, its successors and assigns or the Grantee, its successors and assigns, after reasonable notice, any or all of the following remedies may be exercised: 1) institute suits to enjoin any breach or enforce any covenant by ex parte, temporary, and/or permanent injunction; and 2) require that the property be restored promptly to the condition required by this Management Agreement.

20. Perpetual Right of Enforcement - Failure on the part of the Grantee to enforce any covenant or provision hereof shall not discharge or invalidate such covenant or any other covenant, condition or provision hereof or affect the right of the Grantee to enforce the same in the event of a subsequent breach of default.

21. Right of Entry - The Grantee, its successors and assigns, has the right, with reasonable notice, to enter Tick Hill at reasonable times for the purpose of conducting approved research and educational projects. This right of entry does not include access to the interior of buildings and structures. All other protections against trespass by the public remain in effect. Access shall only be through Tacoma Hunting and Fishing Club property or through the 50-foot easement adjacent to John Morgan property (see Exhibit A).

ARTICLE V. GRANTOR'S RIGHTS

22. Grantor's Rights - The Grantor expressly reserves to itself, its personal representatives, heirs, successors and assigns the right to:

a. Continue the timber management uses of Tick Hill;

b. Continue to lease hunting, fishing or trapping rights on Tick Hill subject to relevant laws;

c. Improve, repair, restore, alter, remove, remodel, or replace permitted structures, provided that such activity is consistent with the Management Plan; and

d. Continue the use of Tick Hill for all purposes consistent with this Management Agreement.

ARTICLE VI. RIGHTS OF GRANTEE

23. Rights of Grantee - To accomplish the purpose of this Management Agreement, the following rights are conveyed to the Grantee by this Management Agreement:

a. To preserve and protect the conservation values of Tick Hill;

b. To enter upon Tick Hill at reasonable times in order to conduct approved research and educational projects and to monitor Grantor's compliance with and otherwise enforce the terms of this Management Agreement; provided that such entry shall be upon prior reasonable notice to Grantor, such entry shall be by water, and shall not unreasonably interfere with Grantor's use and quiet enjoyment of Tick Hill;

c. To give permission to research scientists to conduct research and educational projects approved for the Sweet Hall Marsh National Estuarine Research Reserve, provided that permittees carry and display an official permit issued by the Grantee and approved by the Grantor; and

d. To prevent any activities or use of Tick Hill that is inconsistent with the purposes of this Management Agreement and to require the restoration of such areas or features of Tick Hill that may be damaged by any inconsistent activity or use.

ARTICLE VII. GRANTOR'S AND GRANTEE'S LIABILITY

24. Upkeep by Grantor - The Grantor, its successors, and assigns further agree that they shall be responsible for upkeep of Tick Hill and shall hold the Grantee, its successors, and assigns harmless from charges of leins arising out of upkeep or taxes.

25. Taxes - The Grantor agrees to pay any and all real property taxes and assessments levied by competent authority on the property.

26. Grantor's Liability - The Grantor, its successors, and assigns shall not be held responsible for injury to persons or damages to property arising out of any research or educational activity being conducted on Tick Hill pursuant to the Management Plan and this Management Agreement, except those arising out of the negligence of the Grantor, its successors, and assigns. The Grantor's liability for all other activities on Tick Hill shall remain in effect.

The Grantee has inspected Tick Hill and accepts its condition "as is" as described in Exhibit B. Any existing conditions or future conditions relating to permitted uses of Tick Hill by the Grantor, including, without limitation, any hunting and fishing activities, shall not constitute conditions giving rise to a claim of negligence on the part of the Grantor or to any potential liability for damage to property or injury to person. The Grantor's liability for all other activities on Tick Hill shall remain in effect.

27. Grantee's Liability - The Commonwealth of Virginia and all the agencies and institutions are covered by a self-insurance program as authorized by Section 2.1-526.8 of the Code of Virginia which is based upon a comprehensive general liability manuscript policy form. All persons who are not employees of the Commonwealth must receive approval from the Grantor and furnish evidence of liability coverage in the amount of $100,000/$300,000/$100,000. All persons, whether employees of the Commonwealth or not, shall sign a liability release form referenced in paragraph 26 and appearing in Exhibit D.

ARTICLE VIII. PUBLIC ACCESS

28. Public Access - The granting of this Management Agreement does not grant to the public any right to enter the property.

29. Termination - In the event that circumstances arise that cause Tick Hill or Sweet Hall Marsh to be withdrawn from the Chesapeake Bay National Estuarine Research Reserve System in Virginia, cause the Chesapeake Bay National Estuarine Research Reserve System in Virginia to cease to exist, or cause the Grantee to not have sufficient funds to conduct research under the Chesapeake Bay National Estuarine Research Reserve System in Virginia, this contract shall be terminated by the Grantee by providing 90 days written notice to the Grantor. If either party breaches the terms and conditions of this contract, the other party may terminate this contract with 90 days written notice.

30. Right of First Refusal - The Grantee shall have the right of first refusal on any and all sales contracts on the property that the Grantor might obtain during the life of this Management Agreement.

IN WITNESS WHEREOF, the Grantor and Grantee have hereunto set their hands and seals the day and year above written.

Grantor:

_____(SEAL)
Vice President,
Woodlands and Wood Products

_____(SEAL)

ACCEPTED BY

_____ 10/16/90
Frank O. Perkins Date
Dean and Director

AS GRANTEE:

_____(SEAL)

APPROVED AS TO FORM:

Assistant Attorney General for the
Attorney General of Virginia

RECOMMEND:

Director
Division of Engineering and Buildings

RECOMMEND:

Director
Department of General Services

APPROVED FOR THE GOVERNOR:

Pursuant to the provisions of Section 2.1-504.2, Code of Virginia (1950), as amended, and by authority of Executive Order 78 (89), dated December 21, 1989, I hereby approve the acquisition of the demised premises pursuant to this management agreement and the execution of this instrument for, on behalf of, and in the stead of the Governor of Virginia.

Secretary of Administration

10-02-90
Date

Management Agreement

Sweet Hall Marsh National Estuarine Research Reserve in Virginia

THIS MANAGEMENT AGREEMENT, made this 24 day of September, 1990 by and between Tacoma Hunting and Fishing Club, hereinafter called the Grantor, and The College of William and Mary in Virginia, hereinafter called the Grantee.

WITNESSETH

WHEREAS, the Grantor is owner in fee simple of certain real property (hereinafter described and referred to as "Sweet Hall Marsh"), situated in the County of King William, Commonwealth of Virginia, being more particularly delineated as "freshwater tidal wetlands extending from mean low tide on the Pamunkey River to the wetland/upland border landward of the Pamunkey River" as shown in Exhibit A and described in Exhibit B, attached hereto and incorporated by reference herein; and

WHEREAS, Sweet Hall Marsh has substantial wetland resources and significant natural, ecological, research, educational, and aesthetic values, which this management agreement will help to preserve, maintain, and protect water quality and important aquatic resources and habitats of the Pamunkey River; and

WHEREAS, the specific natural, ecological, research, educational, and aesthetic values of Sweet Hall Marsh are documented in the ecological survey made by the Virginia Institute of Marine Science (VIMS) on behalf of the Grantee and dated August 31, 1990 (Exhibit C), which will serve as an information base for monitoring and enforcement purposes and will be kept current by VIMS; and

WHEREAS, this Management Agreement is being made with the intention and understanding of both the Grantor and Grantee that the subject property will be designated as a component of the Chesapeake Bay National Estuarine Research Reserve System in Virginia and the National Estuarine Research Reserve System; and

WHEREAS, the Grantor desires and intends that the natural, ecological, research, educational, and aesthetic values of Sweet Hall Marsh shall be preserved and maintained by restricting and limiting the use of the land and contiguous water areas of the property, on the terms and conditions and for the purposes hereinafter set forth, and the Grantee is willing to accept responsibility for managing the property for the purpose of conducting basic scientific and applied research and providing timely and accurate information to the Grantor and the citizens of the Commonwealth regarding the quality and conservation of the resources, both living and non-living, of Sweet Hall Marsh, on the terms and conditions and for the purposes hereinafter set forth; and

NOW THEREFORE, as an absolute gift gift of no monetary consideration ($0.00) but in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, the Grantor hereby conveys to the Grantee, its successors, and assigns for a period of five (5) years a Management Agreement for the purpose of research, observation, and education and to the extent hereinafter set forth with respect to Sweet Hall Marsh.

To achieve these objectives, the following conditions and restrictions are set forth:

ARTICLE I. GENERAL PURPOSE AND DURATION

1. General Purpose - The purpose of this Management Agreement is to preserve and protect the environment of Sweet Hall Marsh and to maintain its natural and cultural values and its dominant scenic, rural, woodland, and wetland character so that the property remains suitable for long-term research on natural and human processes occurring within the Pamunkey River Tributary of the Chesapeake Bay.

2. Duration - This Management Agreement shall be valid for a 5 year period, and the terms, conditions, restrictions and purposes imposed with this Management Agreement shall not only be binding on the Grantor but also the Grantor's agents, personal representatives, heirs, assigns and all other successors to the Grantor's interests for the duration of the Management Agreement, subject to the agreed upon termination provisions. This Management Agreement may be renegotiated at the end of the 5 year period at the discretion of both parties.

ARTICLE II. MANAGEMENT OBJECTIVES

3. Management Plan Preparation and Implementation - There shall be a Management Plan prepared for Sweet Hall Marsh to provide general guidelines for the current and future use of the property. The Management Plan shall address appropriate wetlands and forest management activities, wildlife and waterfowl needs, and research and education uses of Sweet Hall Marsh, and it shall provide any other applicable guidelines for the conservation of natural resources.

The Management Plan shall be prepared by VIMS, in consultation with other resource management agencies of the Commonwealth, and shall be submitted to the Grantor and Grantee for their review and approval, within 6 months of the execution of this Management Agreement. The Grantor and Grantee shall meet at least annually, and more frequently at the request of either party, to review the Management Plan and research results and, where appropriate, to develop more specific recommendations for carrying out certain aspects of the Plan. The Management Plan shall be updated at least every 5 years.

4. On-Site Management - VIMS is the agency designated by the Grantee and the Governor of the Commonwealth of Virginia to manage the **Chesapeake Bay National Estuarine Research Reserve System in Virginia.** In this capacity, VIMS shall serve as on-site manager for research on Sweet Hall

Marsh and shall be responsible for seeing that research conducted on the property is conducted in a manner consistent with the goals of the Chesapeake Bay National Estuarine Research Reserve System in Virginia, the objectives of the Management Plan, and the wishes of the Grantor and Grantee. The on-site manager will be the Grantee's primary representative for the purpose of monitoring uses of the property for consistency with this Management Agreement.

5. Natural Area Preservation - Sweet Hall Marsh shall be maintained as open space, wildlife and waterfowl habitat, and a natural field laboratory for research, consistent with the resource protection policies of the Grantor. Any industrial and commercial activities shall be prohibited on Sweet Hall Marsh. The protection and conservation of the marsh and bottomlands subject to this Management Agreement is consistent with the goals and policies of the Chesapeake Bay National Estuarine Research Reserve System in Virginia.

6. Research and Education - Sweet Hall Marsh shall be used for research and education activities associated with the Chesapeake Bay National Estuarine Research Reserve System in Virginia. Research and education uses of Sweet Hall Marsh shall be in accordance with the principles, objectives, and performance standards set forth in the Management Plan developed by VIMS and approved by the Grantor and Grantee, it being understood that the proposed research and education activities will not involve large groups of people or continuous or frequent visits to the site by other than the few regularly designated research personnel of VIMS. A steering committee shall be convened by VIMS to assist in the review and approval of proposals for research and education activities at Sweet Hall Marsh. Proposals and activities shall be approved by the Grantor and Grantee. Such approval shall not be unreasonably withheld.

7. Information Exchange - Research and education activities conducted at Sweet Hall Marsh shall be used to enhance awareness, understanding, and wise use of estuarine environments. VIMS shall provide the Grantor and Grantee with an annual report on research and education activities conducted at Sweet Hall Marsh and shall disseminate timely and accurate information to the Governor, General Assembly, State and local agencies, industry, and citizens of the Commonwealth regarding the living and non-living resources of Sweet Hall Marsh and their relationship to the Chesapeake Bay system and the coastal waters of the Commonwealth of Virginia.

ARTICLE III. CONTROLLED ACTIVITIES

8. Wetlands and Forest Maintenance - Wetlands shall be protected and maintained in accordance with the Management Plan and the Wetland Guidelines developed pursuant to Chapter 2.1 of Title 62.1 of the Code of Virginia. Forest management activities shall be conducted in accordance with Best Management Practices promulgated by the Commonwealth of Virginia, Division of Forestry and recommended by the U.S. Department of Agriculture, Forest Service and Soil Conservation Service. There shall be no other destruction or alteration of wetlands on Sweet Hall Marsh, except as needed to eradicate noxious plant species, and as approved by the Grantor and Grantee.

Management activities shall not materially impair the scenic quality of Sweet Hall Marsh.

9. Waterfowl and Wildlife Maintenance - Waterfowl and wildlife maintenance activities shall be conducted in accordance with the Management Plan. In general, such activities shall be limited to maintenance of existing habitat and minor improvements, where necessary (such as tree thinning to improve understory vegetation, opening of small areas to provide a greater diversity of habitats, raising and releasing of geese and ducks), and as approved by the Grantor and Grantee. Any waterfowl and wildlife management activities shall be carried out under the guidance of the Commonwealth of Virginia, Department of Game and Inland Fisheries and the U.S. Department of the Interior, Fish and Wildlife Service. Any plant and insect management activities that may affect species of plants or insects protected under the Virginia Endangered Plant and Insect Species Act shall be carried out under the guidance of the Virginia Department of Agriculture and Consumer Services.

10. Hunting and Fishing - The Grantor may pursue such hunting and fishing activities as it may elect as long as such activities are in compliance with applicable state or federal law.

11. Water Quality - There shall be no human activities on or uses of Sweet Hall Marsh that are detrimental or adverse to the maintenance and conservation of surface and subsurface water quality. There shall be no manipulation or alteration of natural water courses, shorelines, marshes or other water bodies, nor shall there be activities conducted on or around Sweet Hall Marsh or the Pamunkey River that could alter natural water level, flow, salinity, or turbidity of Sweet Hall Marsh or the Pamunkey River, or both.

12. Structures, Roads, and Trails - There shall be no restrictions on the Grantor's right to construct hunting blinds or install nesting boxes or similar structures throughout the marsh. There shall be no new buildings, facilities, piers, roads, or trails constructed on Sweet Hall Marsh, except those designed, constructed and utilized by the Grantee for research, education, and naturalistic purposes. Any such construction must be planned for in the Management Plan, and approved by the Grantor and Grantee. Similarly, removal of existing research or education structures must be planned for in the Management Plan and approved by the Grantor and Grantee.

13. Signs and Billboards - Display of billboards, signs or other advertisements is not permitted on or over Sweet Hall Marsh except to state the name and/or address of the owner, to provide notice of the designation as a Chesapeake Bay National Estuarine Research Reserve in Virginia, to post the property as a No Wake Zone, and/or to post the property against trespass.

14. Subdivision - Sweet Hall Marsh shall not be partitioned or subdivided during the life of this management agreement.

15. Excavation, Dredging, and Mining - Excavation, dredging, mining and removal of loam, gravel, soil, rock, sand, coal, petroleum and other materials or alteration of the topography of the land is prohibited on the Sweet Hall Marsh except as related to the collection of geological data. Such activities shall be planned for in the Management Plan and approved by the Grantor and Grantee.

16. Industrial and Commercial Activities - No industrial or commercial activities shall be conducted at Sweet Hall Marsh.

17. Trash, Rubbish, and Waste - Neither the Grantor or the Grantee shall authorize dumping of soil, trash, ashes, garbage, waste, or offensive materials on Sweet Hall Marsh or filling in of any wetland, pond or waterway and such dumping shall be absolutely prohibited. Neither the Grantor or the Grantee shall not be responsible for unauthorized dumping.

18. Off Road Vehicles - Neither the Grantor or the Grantee shall authorize operation of motor vehicles, trail bikes or all-terrain vehicles on Sweet Hall Marsh, except as related to research and hunting activities approved by the Grantor.

ARTICLE IV. ENFORCEMENT AND REMEDIES

19. Injunctive Relief and Restoration - Upon any breach of the terms of this management agreement by the Grantor, its successors and assigns or the Grantee, its successors and assigns, the breaching party may be subject to suit to (1) enjoin any breach or enforce any covenant by temporary restraining order, preliminary and/or permanent injunction; (2) require that the property be restored promptly to the condition required by this management agreement; or (3) seek any other remedy available, in law or equity, to assure compliance with the terms of this Management Agreement.

20. Perpetual Right of Enforcement - Failure on the part of the Grantee to enforce any covenant or provision hereof shall not discharge or invalidate such covenant, or any other covenant, condition, or provision hereof, or affect the right of the Grantee to enforce the same in the event of a subsequent breach or default.

ARTICLE V. GRANTOR'S RIGHTS

21. Grantor's Rights - The Grantor expressly reserves to itself, its personal representatives, heirs, successors and assigns the right to:

a. Continue the naturalistic uses of Sweet Hall Marsh under the terms and conditions set forth herein;

b. Continue to hunt, fish or trap on Sweet Hall Marsh and raise and release ducks and geese subject to applicable laws;

c. Improve, repair, restore, alter, remove, remodel, or replace permitted structures, provided that such activity is consistent with the Management Plan; and

d. Continue the use of Sweet Hall Marsh for all purposes consistent with this Management Agreement.

ARTICLE VI. RIGHTS OF GRANTEE

22. Rights of Grantee - To accomplish the purpose of this Management Agreement the following rights are conveyed to the Grantee by this Management Agreement:

a. To preserve and protect the conservation values of the Sweet Hall Marsh;

b. To enter upon the Sweet Hall Marsh at reasonable times in order to conduct approved research and educational projects and to monitor Grantor's compliance with and otherwise enforce the terms of this Management Agreement; provided that such entry shall be upon prior reasonable notice to Grantor, such entry shall be by water, and shall not unreasonably interfere with Grantor's use and quiet enjoyment of the Sweet Hall Marsh; and further provided that any such entry during a period commencing two weeks prior to the migratory waterfowl seasons in the Commonwealth of Virginia shall be made only with prior notice to and consent from the Grantor, which consent may be withheld in the grantor's sole discretion;

c. To give permission to research scientists to conduct research and educational projects approved for the **Sweet Hall Marsh National Estuarine Research Reserve**, provided that permittees carry and display an official permit issued by the Grantee and approved by the Grantor; and

d. To prevent any activities or use of the Sweet Hall Marsh that is inconsistent with the purposes of this Management Agreement and to require the restoration of such areas or features or the Sweet Hall Marsh that may be damaged by any inconsistent activity or use.

ARTICLE VII. GRANTOR'S AND GRANTEE'S LIABILITY

23. Upkeep by Grantor - The Grantor, its successors, and assigns further agrees that it shall be responsible for upkeep of Sweet Hall Marsh and shall hold the Grantee, its successors and assigns harmless from charges or liens arising out of upkeep or taxes.

24. Taxes - The Grantor agrees to pay any and all real property taxes and assessments levied by competent authority on the property.

25. Grantor's Liability - The Grantor, its successors, and assigns shall not be held responsible for injury to persons or damages to property arising out of any research or educational activity being conducted on Sweet Hall Marsh pursuant to the Management Plan and this management agreement, except those arising out of the negligence of the Grantor, its successors,

and assigns. All persons participating in research or educational activities at Sweet Hall Marsh must sign a liability release form indemnifying and holding harmless the Grantor, its officers, directors, agents, and guests, from any and all liability, claims, or expenses for injury, death or damages to self or property, including without limitation attorney's fees, resulting from or arising out of or in anyway relating to the activities of the Grantee, any of its representatives, agents or guests, or resulting from, or occurring in the course of transit to or from Sweet Hall Marsh. A copy of the release form appears as Exhibit D.

The Grantee has inspected Sweet Hall Marsh and accepts its condition "as is" as described in Exhibit C. Any existing conditions or future conditions relating to permitted uses of Sweet Hall Marsh by the Grantor, including without limitation any hunting and fishing activities, shall not constitute conditions giving rise to a claim of negligence on the part of the Grantor or to any potential liability for damage to property or injury to person. The Grantor's liability for all other activities on Sweet Hall Marsh shall remain in effect.

26. Grantee's Liability - The Commonwealth of Virginia and all its agencies and institutions are covered by a self-insurance program as authorized by Section 2.1-526.8 of the Code of Virginia which is based upon a comprehensive general liability manuscript policy form as shown in Exhibit E. All persons who are not employees of the Commonwealth must receive approval from the Grantor and furnish evidence of liability coverage in the amount of $100,000/$300,000/$100,000 before participating in research or education activities at Sweet Hall Marsh. All persons, whether employees of the Commonwealth or not, shall sign a liability release form referenced in paragraph 25 and appearing in Exhibit D.

ARTICLE VIII. PUBLIC ACCESS

28. Public Access - The granting of this Management Agreement does not grant to the public any right to enter the property. The Grantor reserves the right to place a gate or chain with a lock across any and all roads leading into Sweet Hall Marsh. If a lock is employed, a key will be made available to the Grantee to use for authorized purposes by authorized personnel only in accordance with the Management Plan and the terms of this agreement. The Grantee's right of entry permits use of the Grantor's pier for a tide guage, water quality sampling, and other activities approved by the Grantor, but does not include access to the interior of buildings or structures. All other protection against trespass by the public shall remain in effect.

ARTICLE IX. MISCELLANNEOUS

28. Transfer and Reversion - The Grantor agrees to send in writing to the Grantee the names and addresses of any party to whom Sweet Hall Marsh is to be transeferred at the time said transfer is executed. The Grantee agrees to hold this Management Agreement exclusively for conservation purposes, and that it will not transfer the management agreement in exchange for money, other property, or services. This provision shall not preclude

the Grantee from using the monetary value of any donations or gifts from the Grantor as match for money, other property, or services that will contribute to fulfilling the objectives of the Management Plan or the terms of this agreement.

The Grantee may assign its rights under this Management Agreement to the Virginia Institute of Marine Science in such manner as to achieve the purposes and conditions herein. If any such assignee shall cease to exist or abandon this Management Agreement or the rights and duties of enforcement herein set force, or if proceedings are instituted for condemnation of this Management Agreement, the Management Agreement and rights of enforcement shall revert to the Grantee. If the Grantee shall be dissolved and if the terms of the dissolution fail to provide a successor, then the court shall appoint an appropriate successor as Grantee.

29. Termination - In the event that circumstances arise that cause Sweet Hall Marsh to be withdrawn from the Chesapeake Bay National Estuarine Research Reserve System in Virginia, cause the Chesapeake Bay National Estuarine Research Reserve System in Virginia to cease to exist, or cause the Grantee to not have sufficient funds to conduct research under the Chesapeake Bay National Estuarine Research Reserve System in Virginia, this management agreement shall be terminated by the Grantee by providing 90 days written notice to the Grantor. If either party breaches the terms and conditions of this management agreement, the other party may terminate this management agreement with 90 days written notice.

30. Right of First Refusal - The Grantor agrees that, before extending any irrevocable offer or entering into any unconditional contract to sell Sweet Hall Marsh to any person other than a shareholder of the Grantor or an entity controlling, controlled by or under common control with the Grantor, or any relative of any of the foregoing, the Grantor shall first provide the Grantee with 30 days written notice of the price at which it is willing to sell Sweet Hall Marsh and providing the Grantee with a first right to negotiate a purchase thereof. If, at the end of such 30 day period, the Grantor and Grantee shall not have entered into an agreement in principle as to the material terms and conditions of a proposed sale of Sweet Hall Marsh to Grantee or, if within 30 days after the date of such agreement in principle, the Grantor and Grantee shall not have entered into a definitive agreement for the sale of Sweet Hall Marsh to Grantee, the Grantor shall be free to make irrevocable offers, enter into such unconditional contracts, or otherwise offer to sell Sweet Hall Marsh as it may elect in its sole discretion.

31. Notification - The Grantor agrees to notify the Grantee, in writing, before exercising any reserved right the exercise of which may have an adverse impact on the conservation interests associated with Sweet Hall Marsh. Any notices by the Grantor to the Grantee pursuant to any provision hereof shall be sent by registered or certified mail, return receipt requested, addressed to Coleman Wortham, III, Davenport & Co. of Virginia, Inc., 801 E. Main Street, Richmond, Virginia 23219, with a copy to William T. Reed, III, P.O. Box 310, Manakin-Sabot, Virginia 23103.

IN WITNESS WHEREOF, the Grantor and Grantee have hereunto set their hands and seals the day and year above written.

Grantor: Jacona Hunting & Fishing Club

by _____ (SEAL)
President

9-27-90 (DATE)

ACCEPTED BY

AS GRANTEE:

Frank O. Perkins (SEAL)

10/29/90 (DATE)

APPROVED AS TO FORM:

Assistant Attorney General for the
Attorney General of Virginia

RECOMMEND:

Director
Division of Engineering and Buildings

RECOMMEND:

Director
Department of General Services

APPROVED FOR THE GOVERNOR:

Pursuant to the provisions of Section 2.1-504.2, Code of Virginia (1950), as amended, and by authority of Executive Order 78 (89), dated December 21, 1989, I hereby approve the acquisition of the demised premises pursuant to this management agreement and the execution of this instrument for, on behalf of, and in the stead of the Governor of Virginia.

Secretary of Administration

10-10-90
Date

APPENDIX B
MANAGEMENT POLICIES FOR YORK RIVER SITES

Designated Research Reserves shall be managed to maintain its aesthetic, topographical, and biological integrity. The Reserve shall be maintained as open space, fish and wildlife habitat, and natural field laboratory for nonmanipulative research. The following policies will apply.

Geology

Surface and subsurface features possessing unique geological characteristics shall be maintained and protected so as to preserve those characteristics from unwarranted disturbance and/or destruction. Visitor access to these features will be limited to insure protection of the features and the safety of the visitor. VIMS will work with the Department of Mines, Minerals and Energy to have a geological survey conducted at each reserve site. Surveys must be conducted by a qualified geologist, recognized in the areas of field investigation.

Pertinent statutes, regulations and guidelines
Virginia Cave Protection Act
Coastal Primary Sand Dune Protection Act

Soils

Excavation, mining, or removal of loam, gravel, rock, sand, coal, petroleum, or minerals or alteration of topography shall not be permitted except as related to the collection of geological and geophysical data. Areas devoted to agricultural use or areas subject to user impact, such as trails, should be developed and/or maintained to minimize damage to and loss of existing soils. Soil maps and soil suitabilities shall be obtained or developed for each research reserve.

Pertinent statutes, regulations and guidelines
Virginia Erosion and Sediment Control Law
Agriculture—Best Management Practices
Guidelines on Construction and Maintenance of Trails (to be developed)

Shorelines

Shorelines shall be preserved in their natural state and existing condition. Restoration of severely eroding shorelines by planting native vegetation may be allowed with approval on an individual basis as an applied research. Opposition to existing and/or proposed off-site activities will be considered if such activities may adversely affect existing shoreline and/or water resources along or within reserve boundaries.

Pertinent statutes, regulations and guidelines
Virginia Erosion and Sediment Control Law
Hydrologic Modifications—Best Management Practices
Subaqueous Guidelines
Coastal Primary Sand Dune Protection Act
Federal Clean Water Act, Section 401
Federal Coastal Zone Management Act

Stream Beds and Channels

Stream beds and channels shall be preserved in their natural state and existing condition. There shall be no manipulation or alteration of natural water courses, channels, or other water bodies, nor shall there be conducted activities on or around the reserve site that could alter natural water level, flow, or both except in conjunction with applied research projects where the impact will be temporary and nondestructive. Opposition to existing and/or proposed off-site activities will be considered if such activities may adversely affect natural water courses, channels, levels, flow, or other resources within the reserve boundaries.

Pertinent statutes, regulations and guidelines
Hydrologic Modifications—Best Management Practices
Watercourses Generally
Minimum Instream Flow Generally
Subaqueous Guidelines
Federal Clean Water Act, Section 401

Water Quality

There shall be no human activities or uses of the reserve site that are detrimental or

adverse to the maintenance, improvement or conservation of existing surface and ground water supplies and quality. All activities within a reserve must be conducted so as to avoid violation of established State Water Control Board Water Quality Standards.

Pertinent statutes, regulations and guidelines

Waters of the State, Ports and Harbors
Federal Clean Water Act
Standards of Water Quality (established by State Water Control Board)
Minimum Instream Flow Generally
Sources Affecting Ground Water—Best Management Practices
Hazardous Waste Management Reglations

Air Quality

No activities shall be permitted in the reserve that have the potential to cause air pollution which exceeds acceptable air quality standards. Air quality will be monitored at appropriate sites.

Pertinent statutes, regulations and guidelines

Federal Clean Air Act
Virginia Air Pollution Control Law
Regulations for the Control and Abatement of Air Pollution

Wetlands

All tidal and nontidal wetlands located within or along reserve boundaries shall be protected in a natural condition. Wetlands include bogs, swamps, freshwater and tidal vegetated marshes, and unvegetated flats.

Pertinent statutes, regulations and guidelines

Virginia Wetlands Act
Federal Clean Water Act, Section 404 and Section 401

Forests

Timber management within the core area of reserve lands should be directed toward the development and preservation of significant old growth stands, except where selective harvesting of mature trees is a traditional use of the property. Disease, insect, or exotic plant control, facility development, and/or stand improvement considerations in the buffer zones shall be the controlling or motivating factors behind decisions to harvest or treat timber. Any harvesting of timber will be conducted in accordance with guidelines established by VDOF. The research reserve program shall work with the Virginia Department of Forestry to develop an inventory and evaluation of standing timber at each site. VIMS will work with the Virginia Department of Agriculture and Consumer Affairs to survey timber stands for forest pests, disease, and exotic and rare/endangered plant species and to develop appropriate pest/disease management procedures.

Pertinent statutes, regulations and guidelines

Forestry—Best Management Practices
Gypsy Moth Control Guidelines (to be developed)

Fish and Wildlife

Game and nongame species shall be managed to preserve the overall health of the various populations within the reserve and to maintain fish and wildlife habitat. Traditional hunting, fishing, oystering, and trapping will be allowed, consistent with applicable laws. VIMS will work cooperatively with the Virginia Department of Game and Inland Fisheries to establish reserve-specific wildlife management plans.

Pertinent statutes, regulations and guidelines

Forestry—Best Management Practices
Agriculture—Best Management Practices
Game and Inland Fisheries Hunting Regulation
Virginia Marine Resources Commission Fishing Regulations

Rare, Threatened or Endangered Species

Areas identified as possessing rare, threatened or endangered species shall be managed, according to recommended regulations and guidelines, to preserve and protect the

species. The presence of an endangered or threatened species shall not necessarily preclude continued or proposed uses of an area. The flora and fauna on research reserves will be surveyed, identified and classified with the assistance of the Virginia Natural Heritage Program and Department of Game and Inland Fisheries.

Pertinent statutes, regulations and guidelines

Federal and State Endangered Species Act
Virginia Endangered Plan and Insect Species Act

Traditional Uses

Traditional hunting, trapping, oystering, and fishing activities will be allowed in accordance with applicable laws. Private landowners may place noncommercial blinds on the reserve for personal use or use by assigns. Agricultural and silvicultural activities within the buffer areas of research lands will be conducted in accordance with environmentally sound practices (BMPs).

Pertinent statutes, regulations and guidelines

Game and Inland Fisheries Hunting Regulations
Virginia Marine Resources Commission Fishing Regulations
Virginia Erosion and Sediment Control Law
Virginia Pesticide Law
Agriculture—Best Management Practices

Structures, Roads and Trails

No new buildings, facilities, structures, piers, roads or trails shall be constructed on the reserve site, except those designed, constructed, utilized in, and accessary to research, education, hunting and naturalistic uses of the reserve site. Such construction shall only be permissable only after the environmental impact of any such construction is fully assessed and approved. Similarly, removal of existing structures shall be assessed for potential environmental impact. There shall be no compulsion to remove existing structures.

Signs and Billboards

Display of signs, billboards, or other advertisements shall not be permitted on or over the reserve sites, except to state the name and/or address of the owner, to provide notice of the designation as a Chesapeake Bay National Estuarine Research Reserve, and/or to post the property against trespass or littering.

Fire

A proactive fire plan to consider wildland fire prevention and supression will be developed in cooperation with the Department of Forestry. A two-phased approach to the prevention, management, and suppression of fire will be encouraged. The plan will take into consideration that fire is a natural process in forest ecology and will not seek to control all fires. However, proactive plans to protect structures, and other significant resources which are sensitive to fire damage and to protect human safety will also be developed. Any prescribed burns to be used for resource management purposes will be conducted only under the supervision of a qualified master burner.

Pertinent statutes, regulations and guidelines

Forest Wardens and Fires

Trash, Rubbish and Waste

No soil, trash, ashes, garbage, hazardous waste, or offensive materials shall be dumped or deposited on the research reserve site. No wetland, pond, or waterway shall be filled.

Off-Road Vehicles

No motor vehicles, trail bikes, or all-terrain vehicles shall be operated at the reserve site, except in designated buffer areas and/or for official reserve management operations.

Archaeological and Historical Sites and Objects

Reserve sites shall be inventoried to locate sites and objects possessing prehistoric and/

or historic significance and plans to protect such sites and objects shall be prepared. Activities which may in some way affect significant sites or objects shall require review and/or permitting by the Division of Historic Landmarks and approved by reserve manager.

Pertinent statutes, regulations and guidelines
Virginia Antiquities Act
Virginia Cave Protection Act
1986 Appropriations Act
National Historic Preservation Act

Historic Buildings, Structures and Objects

Historic structures shall be protected and preserved and the history of such structures shall be incorporated in the reserve's interpretive offerings where appropriate. Eligible structures shall be surveyed and evaluated for nomination to the Virginia Landmarks Register and the National Register of Historic Places. Buildings and structures possessing historic significance shall be protected by established statutes and regulations. Plans for the alteration, remodeling, or redecoration of historic structures on the Virginia Landmarks Register must be submitted to the Division of Historic Landmarks for review and comment to insure that the historic and/or architectural integrity of these properties is maintained.

Pertinent statutes, regulations and guidelines
1986 Appropriations Act
Division of Engineering and Buildings Directive No. 1
National Historic Preservation Act

Collection of Natural, Historical or Cultural Resources

All collecting of plant, animal, mineral, or fossil specimens shall require the prior issuance of a collecting permit by VIMS and the Division of State Parks, where appropriate. The collection of historic or archaeological artifacts will be allowed only with collecting permits approved by the Division of Historic Landmarks. Use of metal detectors by public visitors is prohibited.

Pertinent statutes, regulations and guidelines
Division of Parks and Recreation Regulation No. 5
Virginia Antiquities Act
Virginia Cave Protection Act

Manipulative Research

In order to protect the natural integrity of the research reserve, no manipulative research activities with a significant or long-term adverse impact on reserve resources shall be allowed. Habitat manipulation for resource management purpose shall not be allowed, except as allowed under policies for shorelines, timber, fish, wildlife, and fire management. If waivers of certain policies or portions of policies are determined to benefit the overall management of the research reserve system, they could be considered on an individual basis.

Industrial and Commercial Activities

No industrial or commercial activities shall be conducted in the research reserve core area, with the exception of commercial fishing.

RELEVANT STATE STATUTES AND REGULATIONS AFFECTING PROPOSED RESERVE SITES

Endangered Plant and Insect Species Act

The Endangered Plant and Insect Species Act (Va. Code Ann. Sec. 3.1-1020 et seq.) makes it unlawful for any person to dig, take, cut, process, or otherwise collect, remove, transport, possess, sell, offer for sale, or give away any species native to or occuring in the wild in Virginia that are listed as threatened or endangered.

A license is required to cut or collect any threatened species and records of purchases must be kept. Any person who violates the

provisions will be found guilty of a Class 4 misdemeanor.

Erosion and Sediment Control Law

The Erosion and Sediment Control Law (Va. Code Ann. Sec. 10.1-560 et seq.) states that the Board of Agriculture and Consumer Services shall create regulations for the effective control of soil erosion, sediment deposition and nonagricultural runoff to prevent unreasonable degradation of properties, stream channels, waters and other natural resources.

Land-disturbing activities are regulated by the Act as well. No person may engage in any land-disturbing activity until an erosion and sediment control plan for the land-disturbing activity has been reviewed and approved. Violations or noncompliance will result in the stopping of all or part of the land-disturbing activities. Penalties, injunctions, and other legal actions are outlined in the Act for those found in noncompliance or violation.

Stormwater Management

The Erosion and Sediment Control Law also provides for the establishment of stormwater management programs. The Department of Agriculture and Consumer Services is authorized to promulgate regulations which specify minimum criteria and administrative procedures for stormwater management programs in Virginia. A local government which has adopted a stormwater management program must grant written approval of a plan, the conditions for approval, etc. within a specified time period. Any person who violates any provision of a local ordinance or program shall be guilty of a misdemeanor.

Air Pollution Control Board

The State Air Pollution Control Board is created by this chapter (Va. Code Ann. Sec. 10.1-1300 et seq.) and shall be composed of five members appointed by the Governor for four-year terms. The Board has the power to promulgate regulations, including emergency regulations, abating, controlling and prohibiting air pollution. The Board may create local air pollution control districts to assist the Department in its air monitoring programs, to initiate and make studies relating to air pollution and make recommendations to the Board. Any owner violating this law shall be guilty of a misdemeanor and shall be subject to a fine of not more than $1000 for each violation within the discretion of the court. Each day of continued violation after conviction shall constitute a separate offense.

Virginia Waste Management Act

The Virginia Waste Management Act (Va. Code Ann. Sec. 10.1-1400 et seq.) allows for the creation of the Virginia Waste Management Board which shall consist of seven Virginia residents appointed by the Governor. The Department of Waste Management is continued and also has the power to administer the policies and regulations established by the Board. The Act provides for the requirement of a permit to operate a sanitary landfill or other facility for the disposal, treatment or storage of nonhazardous solid waste. Open dumps are prohibited. Revocation of permits is outlined and the Board is given the power to promulgate regulations. Any person may submit to the Board a notice of intent to file an application for a certification of site approval. The applicant shall submit to the Board a draft impact analysis for the proposed facility within ninety days after the initial briefing meeting. Any person who violates any provision of this Act or regulation shall be assessed a civil penalty of not more than $10,000 for each day of such violation.

Historic Resources Act

The Department of Historic Resources is created in the Act (Va. Code Ann. Sec. 10.1-2200 et seq.) and shall be headed by a Director. The Virginia Historic Landmarks Board is continued as the Board of Historic Resources with seven members appointed by the Governor. The Board may promulgate regulations necessary to carry out the provisions of the Act. Underwater historic property shall be preserved and protected and shall be the exclusive property of the Commonwealth. Any

person violating the provisions of this section shall be guilty of a Class 1 misdemeanor and, in addition, shall forfeit to the Commonwealth any objects recovered.

Endangered Species Act

In this section the General Assembly declares that certain species of fish or wildlife are threatened with extinction and are entitled to preservation and protection as a matter of general state concern (Va. Code Ann. Sec. 29-230 et seq.). The Commission of Game and Inland Fisheries is authorized to issue regulations to implement the provisions of this section. Any person who violates the provisions of this section shall be punished by a fine of not more than $1000, or imprisonment not to exceed six months, or both. The Commission may permit the taking, exportation, transportation or possession of any fish or wildlife which is listed by the provisions of this chapter for zoological, educational, or scientific purposes, wherever such activities are permitted under federal law, regulation, or permit.

Watercourses and Subaqueous Beds

In Section 62.1-1 of the Annotated Virginia Code and its associated sections, all the beds of the bays, rivers, creeks and the shores of the sea within the jurisdiction of the Commonwealth not conveyed by special grant or compact will continue to remain the property of the Commonwealth of Virginia. The Marine Resources Commission is given the authority to issue permits for all other reasonable uses of state-owned bottomlands. A fee of $25 shall be paid for issuing each permit, but if the cost of the project or facility is more than $10,000, the fee paid shall be $100. A fee of $25 shall be paid for recovery of underwater historic property. All royalties or funds that are collected from such agreements or contracts shall be paid into the state treasury to the credit of the Special Public Oyster Rocks Replenishment Fund.

Tidal Wetlands Act

Standards apply for the use and development of wetlands and shall be considered in the determination of whether applications required by this chapter should be granted or denied. The provisions of the guidelines promulgated by the Commissioner of Marine Resources shall be considered in applying the foregoing standards. No person may conduct any activity which would require a permit under a wetlands zoning ordinance unless he has such permit. The person must apply directly to the Marine Resources Commission for a permit. Any person who knowingly, intentionally, negligently or continually violates any order, rule or regulation will be guilty of a misdemeanor. Following conviction, every day the violation continues shall be deemed a separate offense.

Coastal Primary Sand Dune Act

In order to implement the policy in this chapter, the Commission promulgates guidelines which set forth the consequences of the use of these dunes. No person shall conduct any activity which would require a permit under a coastal primary sand dune ordinance unless he has such permit. In the Coastal Primary Sand Dune Protection Act or an ordinance adopted pursuant to it, all the duties and responsibilities and procedures specified in the Wetlands Act will be followed.

Fish, Oysters, Shellfish, etc.

In Section 28.1-1 et seq. of the Annotated Virginia Code, the Marine Resources Commission jurisdiction extends to the fall line of all tidal rivers and streams and the Commission shall have the jurisdiction over all commercial fishing and all marine fish, marine shellfish, and marine organisms below the fall line on all tidal waters of the Commonwealth. It is unlawful for any person to remove from the waters of this state under the jurisdiction of the Commission any marine fish, marine shellfish, or marine organisms without having first a collection permit. The Commission shall have the power to establish a license commensurate with other

licenses in the amount not to exceed $100 for any device used for the taking and catching of seafood in the waters of the Commonwealth. The Commission, after ten days' notice to any person having a license issued to it may revoke such license for violations of any provisions of this title.

Groundwater Act of 1973

The administration and enforcement of the provisions of this chapter lie with the State Water Control Board and The Department of Health jointly (Va. Code Ann. Sec. 62.1-44.83). No certificate of groundwater right, permit or registration statement authorized by this chapter will be required for any water withdrawal of less than 300,000 gallons a month for groundwater withdrawn for agricultural and livestock purposes. The Board may require persons who withdraw more than 300,000 gallons of water per month in a groundwater management area for the same purposes to report the amount of withdrawal. Whenever, after a public hearing, the Board finds that the permit holder is wilfully violating any provision of a permit the Board may cancel or suspend such certificate or impose conditions on the use therof in order to prevent future violations. Any person adjudged to have violated provisions of this chapter shall be guilty of a misdemeanor.

Scenic Rivers Act

In the Scenic Rivers Act (Va. Code Ann. Sec. 10.1-400 et seq.) the Director of the Department of Conservation and Recreation is empowered to identify rivers or sections of rivers that should be considered for designation because of their scenic, recreational and historic attributes. The agency designated by the General Assembly shall administer the scenic river or section to preserve and protect its use and enjoyment, periodically survey the scenic river and its immediate environs and monitor all existing and proposed uses.

Chesapeake Bay Preservation Act

The Act (Va. Code Ann. Sec. 10-313 et seq.) establishes the Chesapeake Bay Local Assistance Board. The Board is authorized to provide land use and development and water quality protection information. The Board shall also promulgate regulations which establish criteria for use by local governments to determine the ecological and geographic extent of Chesapeake Bay Preservation Areas. Local governments will employ the criteria to ensure that the use and development of land in Chesapeake Bay Preservation Areas shall be accomplished in a manner that protects the quality of the state's waters. The Board adopted regulations on September 20, 1989. These regulations give Tidewater local governments until September 20, 1990 to designate Chesapeake Bay Preservation Areas and employ performance criteria within them.

FEDERAL JURISDICTIONS AFFECTING PROPOSED RESERVE SITES

Agency	*Jurisdiction*	*Legislation*
Army Corps of Engineers	Dredging, filling, dumping, hazards to navigation, wetlands in rivers and larger tributaries	Clean Water Act, Sec. 404; Rivers and Harbors Act, Sec. 10, as amended
Department of Commerce, Office of Ocean and Coastal Resource Management	Oversight of National Estuarine Research Reserve and State Coastal Zone Management programs	Coastal Zone Management Act, as amended
National Marine Fisheries Service	Marine fisheries resources, endangered species, marine mammals	Fish and Wildlife Coordination Act of 1934, Endangered Species Act of 1972, Commercial Fisheries Research and Development Act of 1964, Anadromous Fish Conservation Act of 1965
Sea Grant Program	Research, education and conservation in the coastal zone	Public Law 94461
Department of the Interior, Fish and Wildlife Service	Migratory birds, endangered species, marine mammals, interstate commerce of organisms	Migratory Bird Treaty Act, Endangered Species Conservation Act, Lacey Act, Marine Mammal Protection Act, all as amended
National Park Service	National Register of Historic Places, National Natural Landmarks, National Trust for Historic Preservation	Historic Preservation Act, as amended
Department of Transportation, Coast Guard	Maintenance of navigable waters, shipping, small craft	14 USC 2, Primary Responsibilities of the Coast Guard
Environmental Protection Agency	Air and water quality guidelines, solid waste and toxic materials guidelines, spills, noise pollution, environmental review of projects	Clean Air Act; Clean Water Act; Toxic Substances Control Act; Federal Insecticide, Fungicide and Rodenticide Act; Superfund; National Environmental Policy Act; and Resource Conservation and Recovery Act; all as amended

STATE JURISDICTIONS AFFECTING PROPOSED RESERVE SITES

Agency	*Jurisdiction*	*Legislation*
Virginia Institute of Marine Science	Research in the marine sciences, lead agency in the Chesapeake Bay National Estuarine Research Reserve System in Virginia	VIMS, Va. Code Ann., Sec. 28.1-195 et seq.
Department of Agriculture and Consumer Services	Endangered plants and insects, soil and water conservation, erosion and sediment control, and storm-water management	Endangered Plants and Insects Species Act, Va. Code Ann. Sec. 3.1-1020 et seq. Erosion and Sediment Control Law, Va. Code Ann. Sec. 10.1-560 et seq. Erosion and Sediment Control Law, Va. Code Ann. Sec. 10.1-603.2 et seq.
Department of Air Pollution Control	Air pollution	Air Pollution Control Board, Va. Code Ann. Sec. 10.1-1300 et seq.
Department of Waste Management	Waste management	Virginia Waste Management Act, Va. Code Ann. Sec. 10.1-1400 et seq.
Department of Historic Resources	Historic Resources	Historic Resources, Va. Code Ann. Sec. 10.1-2200 et seq.
Department of Game and Inland Fisheries	Endangered species	Endangered Species Act, Va. Code Ann., Sec. 29-230 et seq.
Virginia Marine Resources Commission	Waters of the state, ports and harbors, subaqueous bottoms, wetlands, fisheries and sand dunes	Va. Code Ann. Sec. 62.1-1 et seq.; Sec. 62.1-3 et seq; Sec. 62.1-13.1 et seq.; Sec. 28.1-1 et seq. Coastal Primary Sand Dune Act, Va. Code Ann. Sec. 62-1.13.21 et seq.
Department of Health; Virginia Water Control Board	Groundwater resources	Groundwater Act of 1973, Va. Code Ann. Sec. 62.1-44.83
Chesapeake Bay Local Assistance Board	Regulations establishing criteria for uses of Chesapeake Bay Preservation Areas	Va. Code Ann. Sec. 10-313 et seq.
Department of Conservation and Recreation	River resources	Scenic Rivers Act, Va. Code Ann. Sec 10.1-400 et seq.
Virginia Department of Transportation	Roads and bridges	